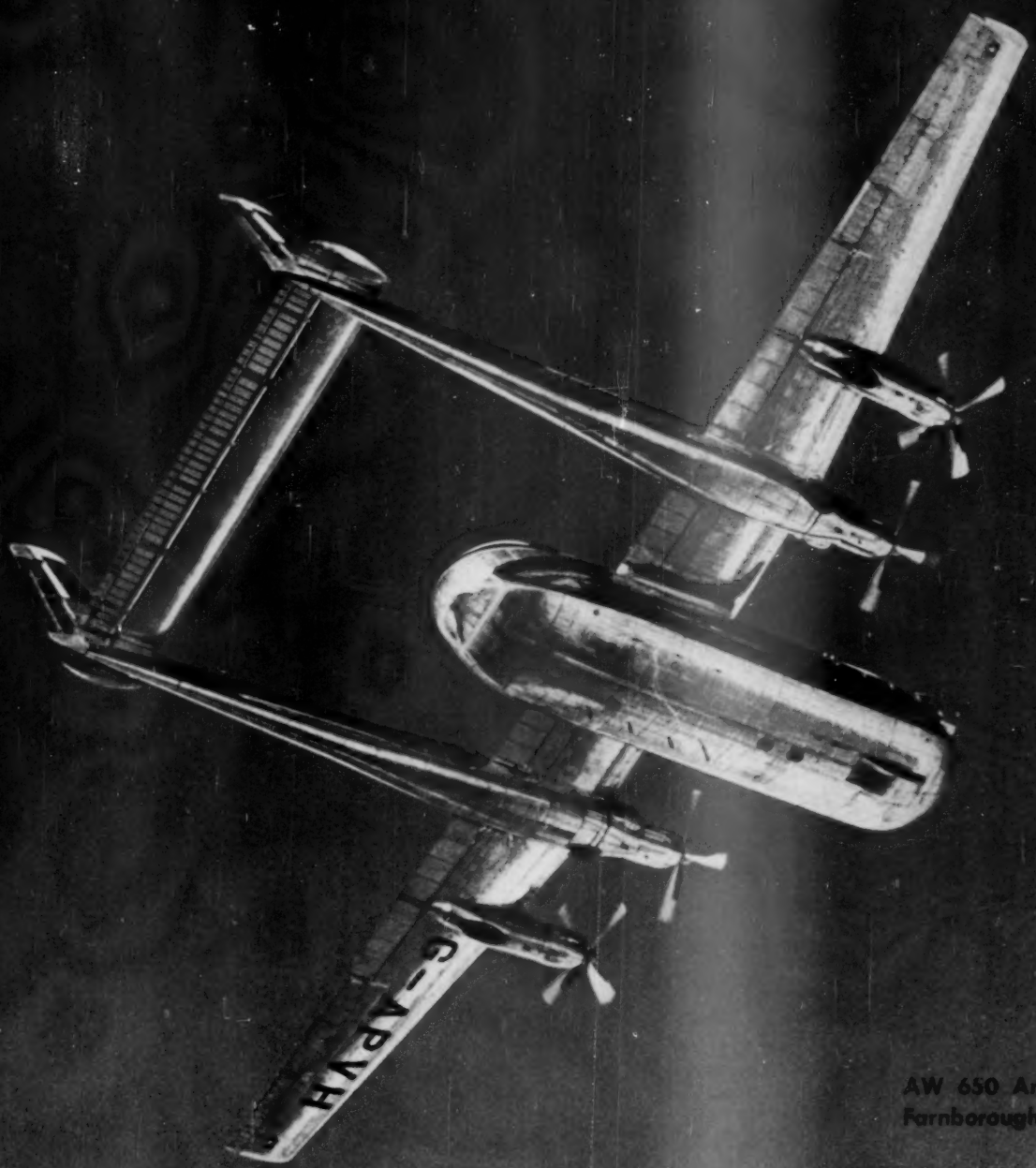
Aviation Week

Including Space Technology

September 21, 1959

EXCLUSIVE REPORT:

Von Karman Views Future



AW 650 Argosy At Farnborough

CONVAIR 880 and 600 JET-LINERS . . . NEW YORK INTERNATIONAL AIRPORT - IDLEWILD

Dramatic Designs YEARS AHEAD FOR YEARS TO COME

Convair's 880 and 600 Jet-Liners and the International Airport at Idlewild will provide every advancement for your jet-age travel in and out of New York. Powered by General Electric CJ-805 engines, Convair jet-liners will utilize new and highly effective G-E developed noise suppression techniques. The world's most beautiful and functional air terminal and the Convair 880 and 600, world's fastest jet-liners, offer you a perfect jet-age combination—dramatic designs that are *years ahead for years to come!*

CONVAIR A DIVISION OF **GENERAL DYNAMICS CORPORATION**

First to offer Convair 880 or 600 Jet-Liner service will be TWA, DELTA, TRANSCONTINENTAL (Argentina), REAL-AEROVIAS (Brazil), S.A.S., SWISSAIR, AMERICAN

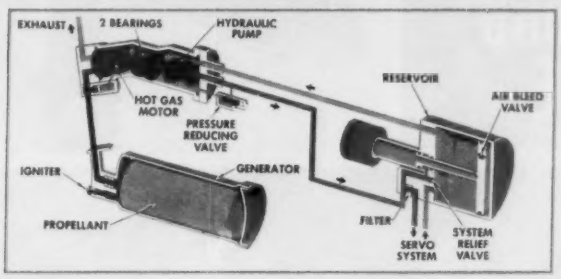
FLIGHT HARDWARE...NOW

VICKERS HOT GAS AUXILIARY POWER SYSTEMS

for missiles and spacecraft

CONCEPT

Vickers piston motors — as used in virtually all existing commercial and military aircraft — are now modified to operate efficiently on propellant-generated hot gas, or bleed gas from the main propulsion system. Minimum weight is achieved by mounting the hot gas motor "shaft-to-shaft" with a Vickers piston hydraulic pump in a common housing. The motorpump, a simple gas generator, hydraulic reservoir, filter, and relief valve are integrally mounted to form a complete Auxiliary Power System in a compact package.



DEVELOPMENT

Production line Vickers hydraulic motors have been operating on hot gas for over 2 years. Units have run on gases as hot as 2300°F without modification.

The present flight hardware was built and tested after an intensive prototype development effort. Test program motorpumps have accumulated over 100 runs each for 1 minute of operation cycle. Since the current development program is aimed at meeting known APS requirements, no limits have been established on the operating cycle duration for this type of equipment.

CONCLUSIONS

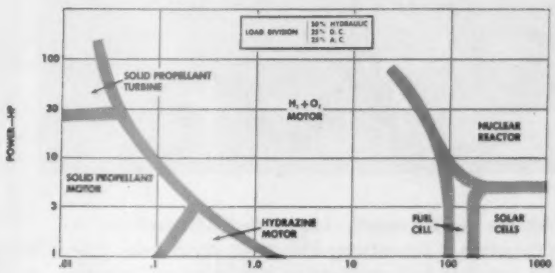
Performance and reliability goals for this concept have been met successfully. A complete hot gas APS package in the 2 - 8 horsepower range, shown above, is available within 90 days. Customer specifications for these and larger systems are invited. Write for Bulletin A-5243

APPLICATIONS

Because of the increasing scope of APS applications, Vickers conducted a series of studies to establish criteria for APS selection. Recent study results (published in March, 1959) indicate that for short duration operation, hot gas motors offer the best weight advantage in the 1 to 30 hp range. See curve below.

Attractive reliability and early delivery resulting from extensive use of proven hardware may extend the application of these systems to an even greater range of second and third generation missiles and spacecraft. Additional advantages include: low speed equipment (up to 10,000 rpm), convenient ground checkout, growth potential, and no alert time required.

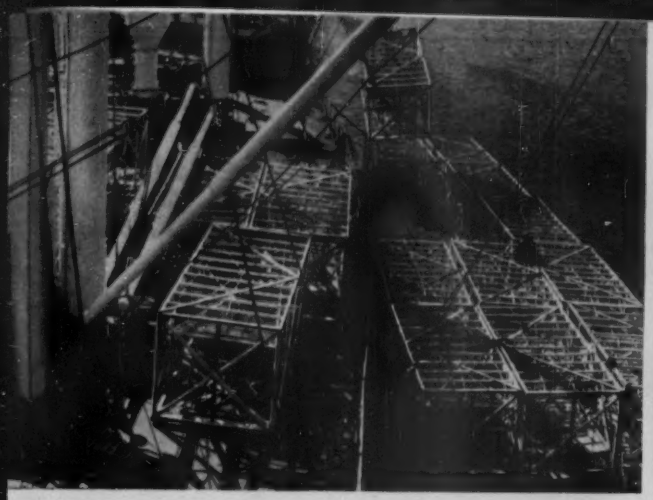
OPTIMUM WEIGHT NON-PROPULSIVE POWER SYSTEMS



AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

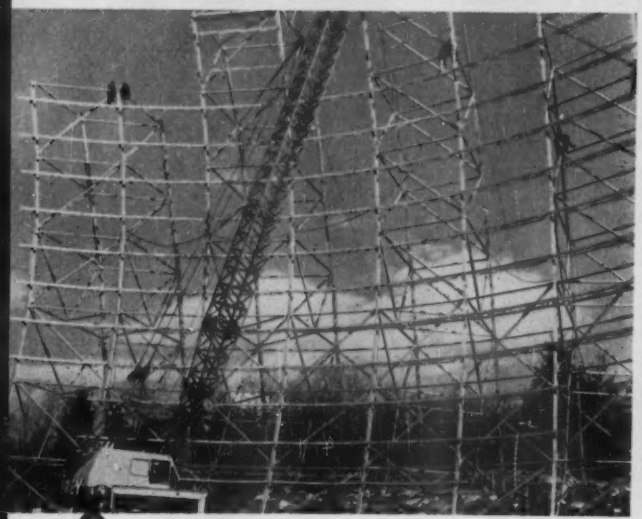
division of:
SPERRY RAND CORPORATION

8386



What you should know about

KENNEDY FIELD ENGINEERING SERVICE



OVER the years Kennedy has expanded its facilities to meet the needs of the antenna industry . . . and today provides a complete field engineering service geared to solve the complex problems of antenna systems installation.

This service, conducted by thoroughly experienced Kennedy field engineers and technicians, includes site selection assembly, erection, trouble shooting and checkout, customer liasion, and on-the-job training for systems personnel in operation and maintenance.

An important fact is underlined here: that Kennedy capability in antenna systems is *total* capability.

ANTENNA EQUIPMENT

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Tracking Antennas-Radio Telescopes-Radar Antennas
"Trans-Horizon" Antennas-Tropospheric Scatter
Ionospheric Scatter

AVIATION CALENDAR

Sept. 28-30—1959 National Symposium on Telemetering, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif. Sponsor: Institute of Radio Engineers' Professional Group on Space Electronics & Telemetry.

Sept. 30-Oct. 2—13th Annual Meeting, Southeastern Airport Managers' Assn., Washington Duke Hotel, Durham, N. C.

Oct. 1-3—23rd Annual Convention, International - Northwest Aviation Council, Multnomah Hotel, Portland, Ore.

Oct. 5-7—Seventh Anglo-American Aeronautics Conference, Institute of the Aeronautical Sciences, Hotel Astor, New York.

Oct. 5-7—Fifth National Communications Symposium, Hotel Utica, Utica, N. Y. Sponsor: Institute of Radio Engineers' Professional Group on Communications.

Oct. 5-9—National Aeronautic Meeting, Society of Automotive Engineers, the Ambassador, Los Angeles, Calif.

Oct. 6—12th Annual Airport Development & Operations Conference, Hotel Onondaga, Syracuse, N. Y. Sponsor: Bureau of Aviation, New York State Department of Commerce.

Oct. 6-8—12th Annual Meeting, National Business Aircraft Assn., Hotel Leamington, Minneapolis, Minn.

Oct. 6-8—Radio Interference Reduction and Electronic Compatibility Conference, Museum of Science and Industry, Chicago, Ill. Conducted by Armour Research Foundation in cooperation with Institute of Radio Engineers' Professional Group on Radio Frequency Interference. (Classified session on Oct. 8.)

Oct. 6-8—National Airports Conference, Norman, Okla. Sponsors: American Assn. of Airport Executives and the University of Oklahoma, in cooperation with FAA.

Oct. 6-8—Industry-Military Quality Control Management Symposium, Oklahoma City Air Materiel Area, Tinker AFB, Okla.

(Continued on page 6)

AVIATION WEEK Including Space Technology
September 21, 1959
Vol. 71, No. 12

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Precision production of jet engine components is a job for specialists. Broader use of jet-propulsion in helicopters, missiles and drones puts new demands on the high performance small jet engine . . . and on the precision workmanship required in the manufacture of its parts. "Hot end" components must withstand high stresses and temperatures . . . require exacting fabrication, welding, machining and inspection . . . to close dimensional tolerances.

Lavelle specializes in producing precision sheet metal engine components. Combustion chambers, casings, exhaust nozzles and housings are typical parts produced in quantity for principal turbojet and turboprop engine manufacturers. They depend on Lavelle's experience and facilities for quality workmanship, dependable delivery . . . at reasonable cost.

An illustrated brochure details Lavelle's ability to produce the precision aircraft components you need . . . when you need them. Write for your copy today.

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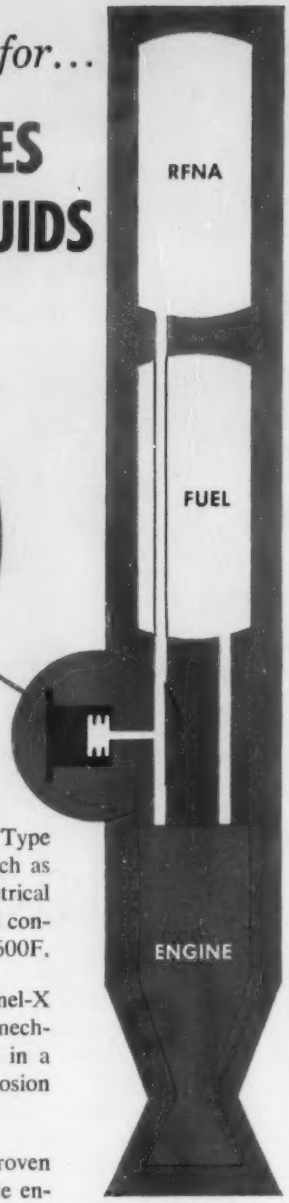
Pressure Potentiometers for...

HIGH TEMPERATURES and CORROSIVE FLUIDS

Type P103
Pressure Potentiometer
shown ¾ size



New Trans-Sonics* Pressure Potentiometers, Type P103, measure pressures of corrosive fluids such as red fuming nitric acid (RFNA) and unsymmetrical dymethylhydrazine (UDMH) for telemetry and control applications at ambient temperatures up to 600F.

Corrosive fluids are contained by a welded Inconel-X bellows which actuates a dynamically balanced mechanism. This mechanism is hermetically sealed in a stainless steel case for protection against corrosion and other environmental hazards.

Accurate and reliable performance has been proven under the following conditions typical of missile environments: *Random Gaussian Vibration* 0.1g²/cps, 15 to 2,000 cps; *Acceleration* 75g; *Shock* 75g.

Flexibility of installation is assured by small size and light weight. Dimensions are 1⅞" diameter by 1⅞" long. Weight is only 6 ounces. Standard ranges are 0-100 and 0-150 psia . . . other ranges to special order. Write for Technical Bulletin P103 to Trans-Sonics, Inc., Dept. 7, Burlington, Mass.

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*TRADEMARK

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(Continued from page 5)

Oct. 6-9—International Symposium on High-Temperature Technology, Asilomar Conference Grounds, Monterey Peninsula, Calif. Sponsor: Stanford Research Institute.

Oct. 7-8—Second Advanced Propulsion Systems Symposium, New England Mutual Hall, Boston, Mass. Sponsors: Air Force Office of Scientific Research; Avco-Everett Research Laboratory.

Oct. 7-9—Sixth National Symposium on Vacuum Technology, American Vacuum Society, Sheraton Hotel, Philadelphia, Pa.

Oct. 7-9—Special Research and Development Conference, American Management Assn., Biltmore Hotel, New York.

Oct. 7-10—Fourth Annual National Meeting, Air Traffic Control Assn., Biltmore Hotel, Oklahoma City, Okla.

Oct. 7-10—Semiannual Convention, American Society of Tool Engineers, St. Louis.

Oct. 8-10—Society of Experimental Test Pilots' Symposium on Pilot's Role in Space Exploration, Beverly Hilton Hotel, Beverly Hills, Calif. Third Annual Awards Banquet, Oct. 10.

Oct. 11-16—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 11-16—Fall General Meeting, American Institute of Electrical Engineers, Hotel Morrison, Chicago, Ill.

Oct. 12-14—14th Annual National Convention and Logistics Forum, National Defense Transportation Assn., Olympic Hotel, Seattle, Wash.

Oct. 12-14—Annual Meeting, National Association of State Aviation Officials, Mark Hopkins Hotel, San Francisco, Calif.

Oct. 12-14—15th National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 12-16—15th Annual General Meeting of the International Air Transport Assn., Imperial Hotel, Tokyo, Japan.

Oct. 12-16—NASA's 1959 Inspection, Langley Research Center, Hampton, Va.

Oct. 14-15—1959 Science and Industry Conference and Exhibit, Conference Bldg., Balboa Park, San Diego, Calif. Sponsor: San Diego County Industries Assn., in cooperation with the Small Business Administration and Department of Defense.

Oct. 14-23—"William Tell II" Seventh World-Wide Interceptor Weapons Meet, Tyndall AFB, Panama City, Fla. Host: Air Defense Command.

Oct. 19-20—15th Annual Convention, Magnesium Assn., Hotel Roosevelt, New York.

Oct. 19-23—47th National Safety Congress, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Oct. 19-25—Annual Meeting, Aircraft Owners and Pilots Assn., Galt Ocean Mile Hotel, Fort Lauderdale, Fla.

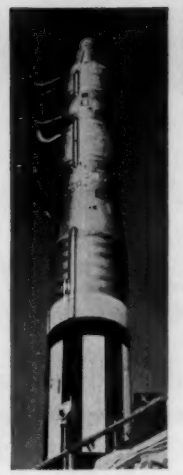
Oct. 20-21—Conference on Hypervelocity Projection Techniques, University of Denver, Denver, Colo.

Oct. 20-22—Tenth National Conference on Standards, American Standards Assn., Sheraton-Cadillac Hotel, Detroit, Mich.

Oct. 21-23—1959 Annual Meeting, Society for Experimental Stress Analysis, Pick Fort Shelby Hotel, Detroit, Mich.

Another member of our
ICBM family of missiles
is the result of a concept
which is itself a...

titan



Titan, America's largest intercontinental ballistic missile, powerful enough to carry an H-bomb a distance of more than 5,500 miles, is a significant milestone in our national space program and for the science / government / industry team that conceived and produced it.

The entire plan for the Titan, Thor, and Atlas family of liquid propelled ballistic missiles was established less than five years ago. Experience gained in the Atlas and Thor programs made major contributions to the unprecedented success and progress of Titan. In addition, Titan again demonstrates the basic soundness, efficiency, and economy of the U.S. Air Force's management concept for ballistic missile and related space programs.

Space Technology Laboratories is responsible for over-all systems engineering and technical direction for Titan. Principal associate contractors include: The Martin Company for airframe and system integration, Avco Manufacturing Corporation for nose cone, Bell Telephone Laboratories and Remington-Rand for guidance, Aerojet-General Corporation for propulsion.

Important staff positions at STL are now available for scientists and engineers with outstanding capabilities in propulsion, electronics, thermodynamics, aerodynamics, structures, astrophysics, computer technology, and other related fields and disciplines.

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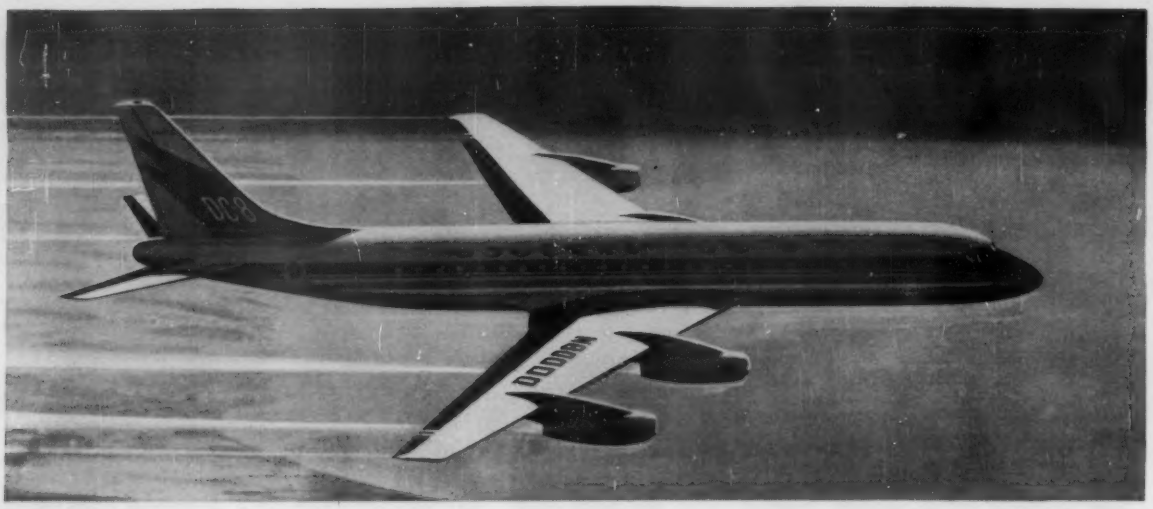
Space Technology Laboratories, Inc.



REQUIRED: A lightweight, low-loss, radiation-free cable with electrical uniformity for interconnecting the navigation and communication antenna circuits of the Douglas Aircraft Co.'s new DC-8 jet airliner.

SPECIFIED: *Foamflex® Coaxial Cable*

A semi-flexible cable with tubular copper inner conductor, foamed polyethylene dielectric and commercially pure aluminum outer conductor.

With outstanding advantages for use in aircraft navigation, communication and warning circuits that include:

1. Twice the efficiency of solid dielectric (RG-8A/U) type of cable now in general use.
2. Extended life characteristics that permit permanent installation and assure electrical stability during the life of the plane.
3. Good frequency response over wide temperature variations; capable of withstanding highest summer ground temperatures, as well as extremely low temperatures found at high altitudes.
4. Greater efficiency and improved system performance without the use of additional electronic components.
5. Ability to operate in both pressurized and non-pressurized parts of a plane without the use of cable dehydrators or pressurizing systems.
6. Lighter and smaller than many cables now installed in aircraft.

Foamflex coaxial cable is supplied in long lengths on lightweight, disposable reels. For further information or inquiries, write Dept. FC.

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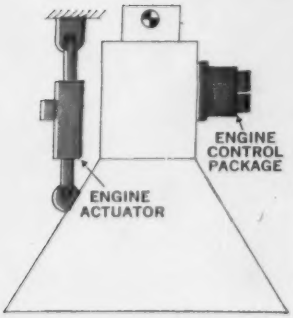
HERE'S WHERE HYDRAULIC RESEARCH INTEGRATED SYSTEMS GO TO WORK



Hydraulic Research designed, developed — and is producing — these two integrated hydraulic control systems for the Atlas missile.

1. INTEGRATED BOOST ENGINE ACTUATOR SYSTEM

Controls engine position. **First qualified control actuator.** Includes:

- High Performance Model 26 Flow Control Transducer
- Hydraulic Actuator
- Filter
- Position Feedback Transducer
- Flow Limiter

2. INTEGRATED CONTROL PACKAGE

Accepts electrical and pressure signals to control fuel flows. The most complex system ever integrated into one package. Includes:

- Five Special Slide Valve Assemblies
- Accumulator
- System Filter and Four Additional Filters
- Three Removable Control Orifices
- Two Check Valves
- Two Servo Valve Mounting Pads
- One Solenoid Operated Three-Way Pilot Section
- One Pressure Operated Three-Way Pilot Section

Hydraulic Research and Manufacturing Company control packages are in wide use on satellites, missiles and manned aircraft. Years of experience and proven capabilities in the electro-hydraulic servo control field provide a single source for the design and production of complex, integrated systems for engine, flight or other control. The company is the originator of the dry torque motor servo valve.

Write for further information.

HR

HYDRAULIC RESEARCH
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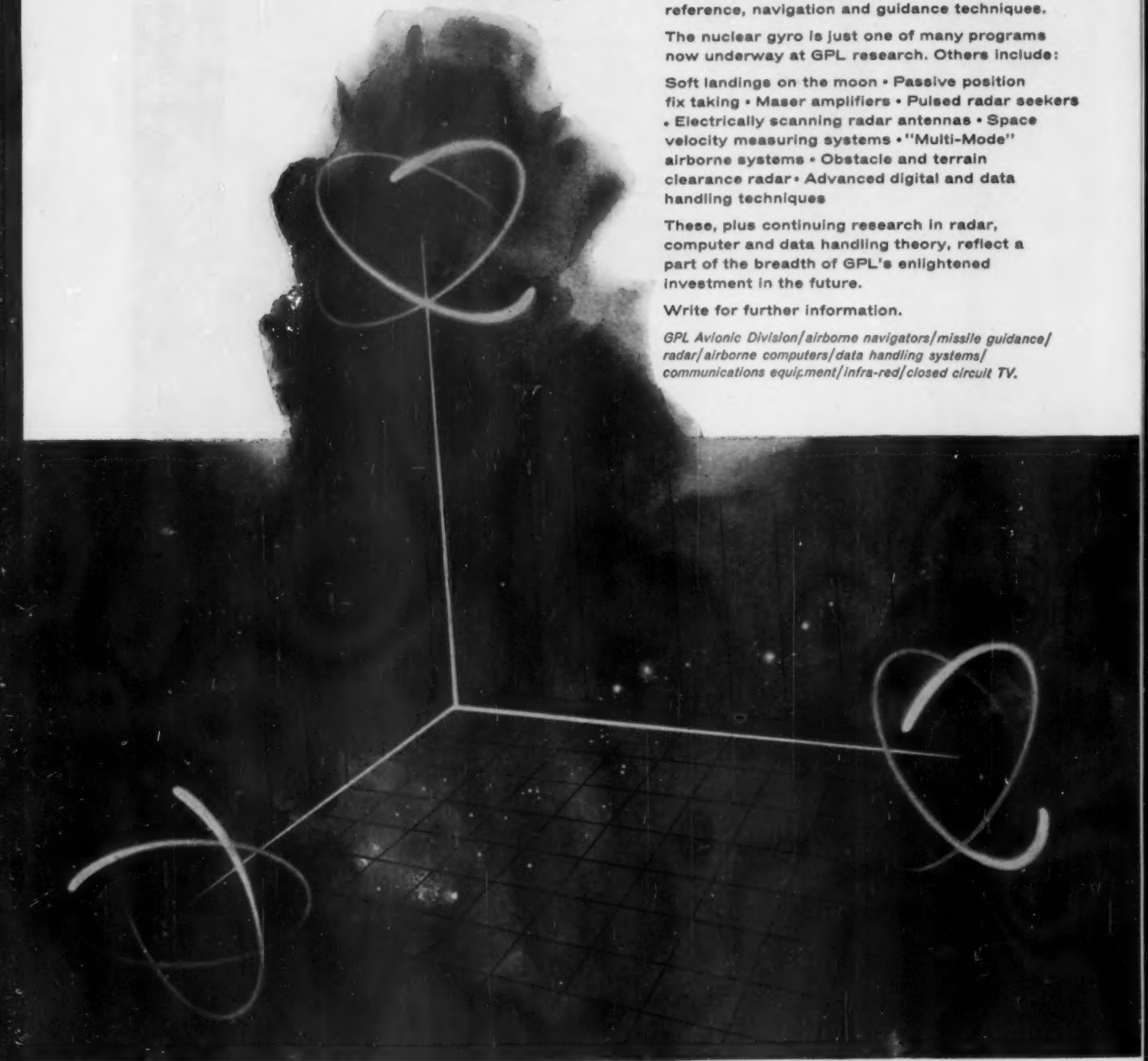
GPL research

Nuclear Gyros



GPL research is now studying for the U.S. Air Force, the feasibility of harnessing the most efficient gyro known to science—the nucleus of the atom. Development of such a gyro—tremendously accurate, perfectly balanced, friction and maintenance free—will revolutionize space reference, navigation and guidance techniques.

The nuclear gyro is just one of many programs now underway at GPL research. Others include:

Soft landings on the moon • Passive position fix taking • Maser amplifiers • Pulsed radar seekers • Electrically scanning radar antennas • Space velocity measuring systems • "Multi-Mode" airborne systems • Obstacle and terrain clearance radar • Advanced digital and data handling techniques

These, plus continuing research in radar, computer and data handling theory, reflect a part of the breadth of GPL's enlightened investment in the future.

Write for further information.

GPL Avionic Division/airborne navigators/missile guidance/radar/airborne computers/data handling systems/communications equipment/infra-red/closed circuit TV.

ENGINEERS — GPL achievements have opened up some unusual research and development opportunities. Send resume to Personnel Director.

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A Subsidiary of General Precision Equipment Corporation

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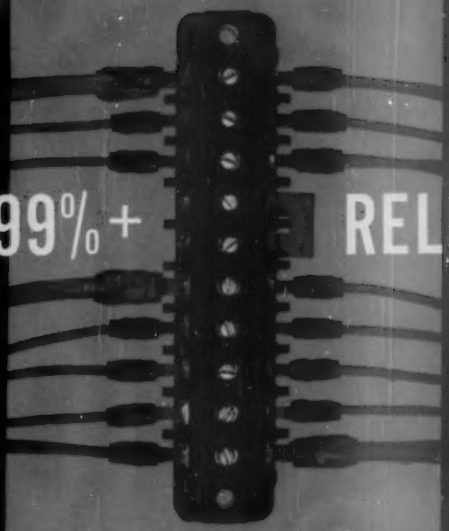

99%+ RELIABILITY

What makes a good terminal block?
Two things. One is quick connection.
The other is absolute dependability.
You get both in a Twin Lock Terminal Block.

Plug in the terminal lug and the connection is made and locked. One twist of the set screw and it's double locked. Fast? It's done in seconds.
Strong? It takes a hundred pounds of force to pull a lug out of its socket.
Positive? It has the least resistance of any mechanical connection.

Write for complete engineering data.

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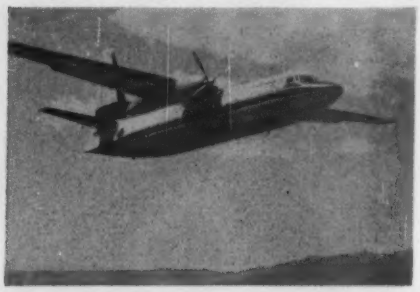
SILICONE NEWS from Dow Corning

In Any Climate, Flexibility

SILASTIC Seals Fairchild F-27 Doors at -50 F

Fairchild's new F-27 propjet brings back the days of the versatile, multi-purpose transport. And one of the reasons this plane can fly anywhere, sit overnight on icy Alaskan runways, and carry a "flexible" payload is Silastic®, the Dow Corning silicone rubber.

This sounds like a lot to ascribe to a door seal, but it does play a really important part. The F-27B's for Northern Consolidated Airlines must be ready to roll in spite of —50 F ground temperatures. Their passenger doors and big cargo doors need Silastic seals because Silastic stays rubbery down to —130 or up to 500 F. With an organic rubber seal, the doors wouldn't open and close at —50. Silastic also resists equatorial weather, and springs back to shape after being compressed under load. So when the door opens to load either passengers or cargo, it will come shut again on a reliable seal that keeps its original properties and holds cabin pressure.



This is typical of the many applications of Silastic in transports, helicopters, military aircraft and other types of planes . . . missiles, too. Your rubber fabricator can engineer a part made of Silastic to your specifications. Or write Dept. 0921.

If you consider *all* the properties of a silicone rubber, you'll *specify Silastic.*

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

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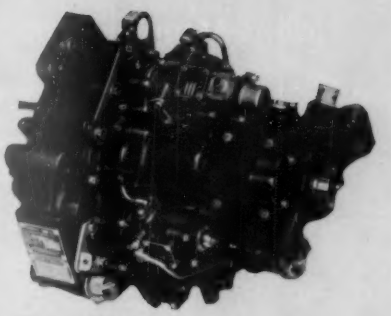

a-c power Sundstrand

"Aboard" the new Douglas DC-8 Jetliners, four Sundstrand 20-kva constant speed drive systems provide over 70,000 watts of reliable constant frequency power . . . enough to light up 100 or more average-sized homes.

Any one of the four drives provides enough power to carry the electrical load required for dependable flight.

To date more than 25,000 Sundstrand drives have proved their reliability in over 6,000,000 flight hours on military and commercial aircraft.

SUNDSTRAND

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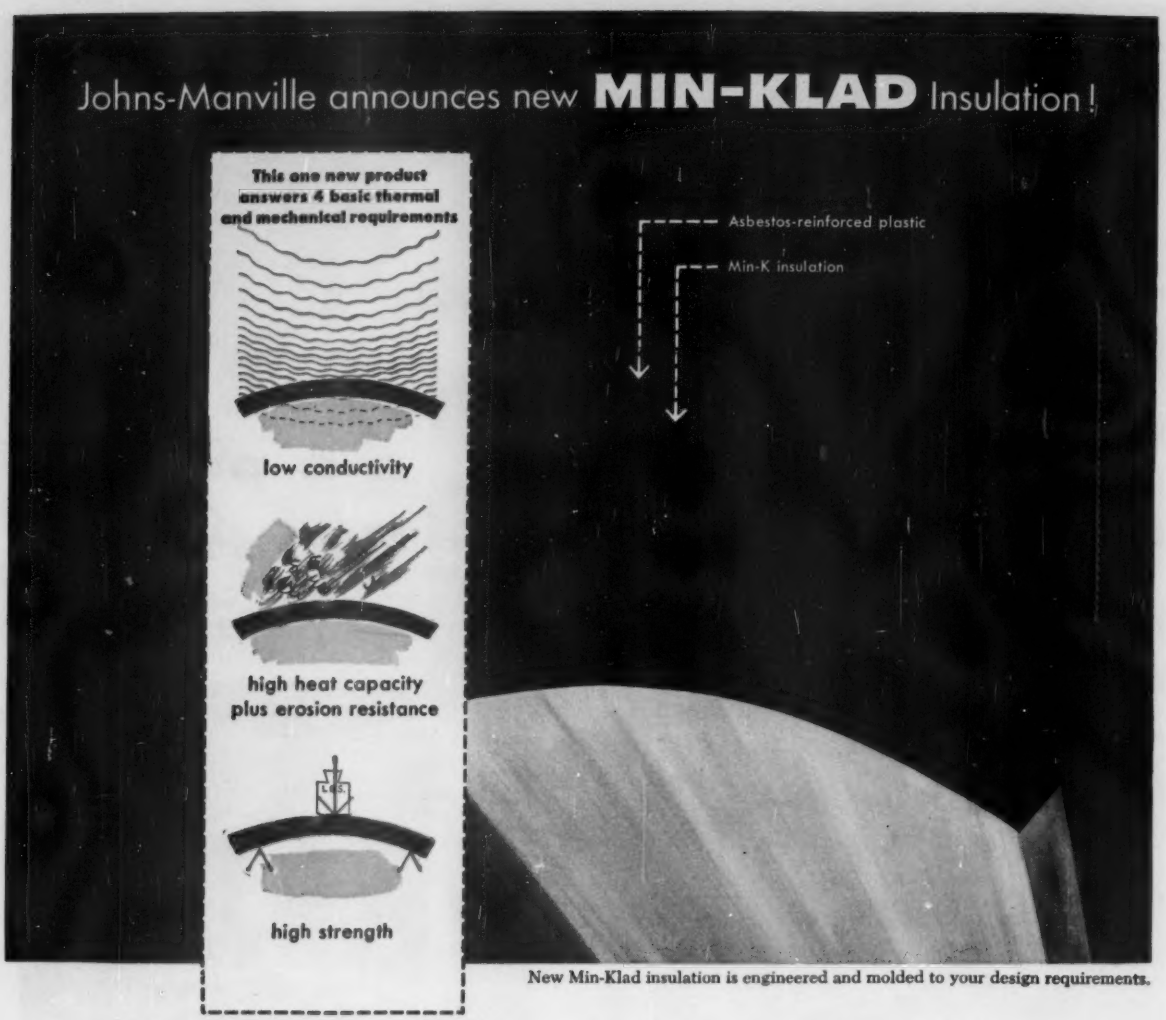
Johns-Manville announces new **MIN-KLAD** Insulation!


This one new product answers 4 basic thermal and mechanical requirements
low conductivity
high heat capacity plus erosion resistance
high strength
Asbestos-reinforced plastic
Min-K insulation

New Min-Klad insulation is engineered and molded to your design requirements.

Combines the capabilities of asbestos-reinforced plastic with the dramatically low conductivity of MIN-K insulation!

New Min-Klad insulation may well be the most significant advance ever made in missile and rocket insulation.

Developed by Johns-Manville research scientists, Min-Klad is the only product of its kind, a permanent lamination of the missile industry's two most effective high-temperature materials: 1) reinforced plastic and 2) J-M's recently developed Min-K insulation.

Does more than plastic alone

Min-Klad gives the missile designer all the advantages of high-temperature plastic: Strength, toughness, rigidity! Erosion resistance! High heat capacity! Yet Min-Klad does more.

It also insulates . . . and with dramatic effectiveness! Its insulating element is J-M's Min-K, an insulation with thermal conductivity that is actually lower than the molecular conductivity of still air. And this conductivity (already less than half that of the best fibrous insulations) drops still further with altitude. At 10 miles, for example, it is decreased by as much as 40%, with further decreases at greater altitudes.

Wide range of applications

Min-Klad offers the missile and rocket designer a rich choice of heat-control possibilities. It may be used for a part that must insulate, yet have the structural advantages of plastic. Where requirements call for a scuff- and erosion-resistant insulating surface . . . or for a good adhesive bond between Min-K insulation and other surfaces. Or, it may be used to control high transient temperatures! For high heat capacity of asbestos-reinforced plastic combined with the low conductivity and heat capacity of Min-K result in a product that provides minimum heat transfer under transient conditions.

Min-Klad is now being tested for approximately two dozen missile and rocket designs. Why not investigate this new material for your present thermal requirements? Upon request, we'll be pleased to send you a sample of the material along with detailed technical information. Write Johns-Manville, Box 14, New York 16, New York. (Ask, too, for information on Min-K insulation and the new aviation insulation brochure IN-185A.) In Canada: Port Credit, Ontario.

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NEW POWER FOR THE NEW AGE IN HELICOPTERS . . .

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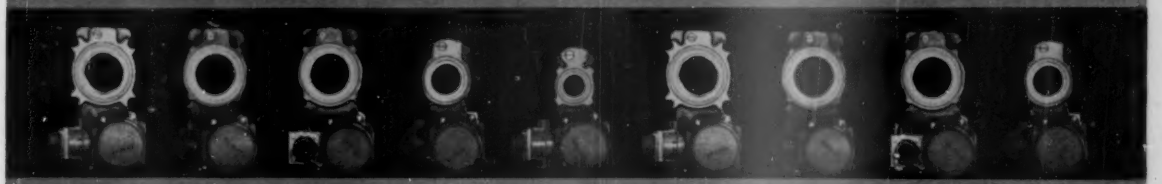

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September 21, 1959

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Including Space Technology

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COVER: Armstrong Whitworth AW 650 turboprop transport, shown during flypast at the Farnborough Air Show, has been modified at the aft fuselage by addition of a breaker strip to reduce turbulence on the tail plane (AW Aug. 17, p. 46). The aircraft is scheduled to make a U. S. sales tour early in 1960; Riddle Airlines has ordered four AW 650s, fitted with Rolls-Royce Dart engines. For other Farnborough details, see p. 32.

PICTURE CREDITS

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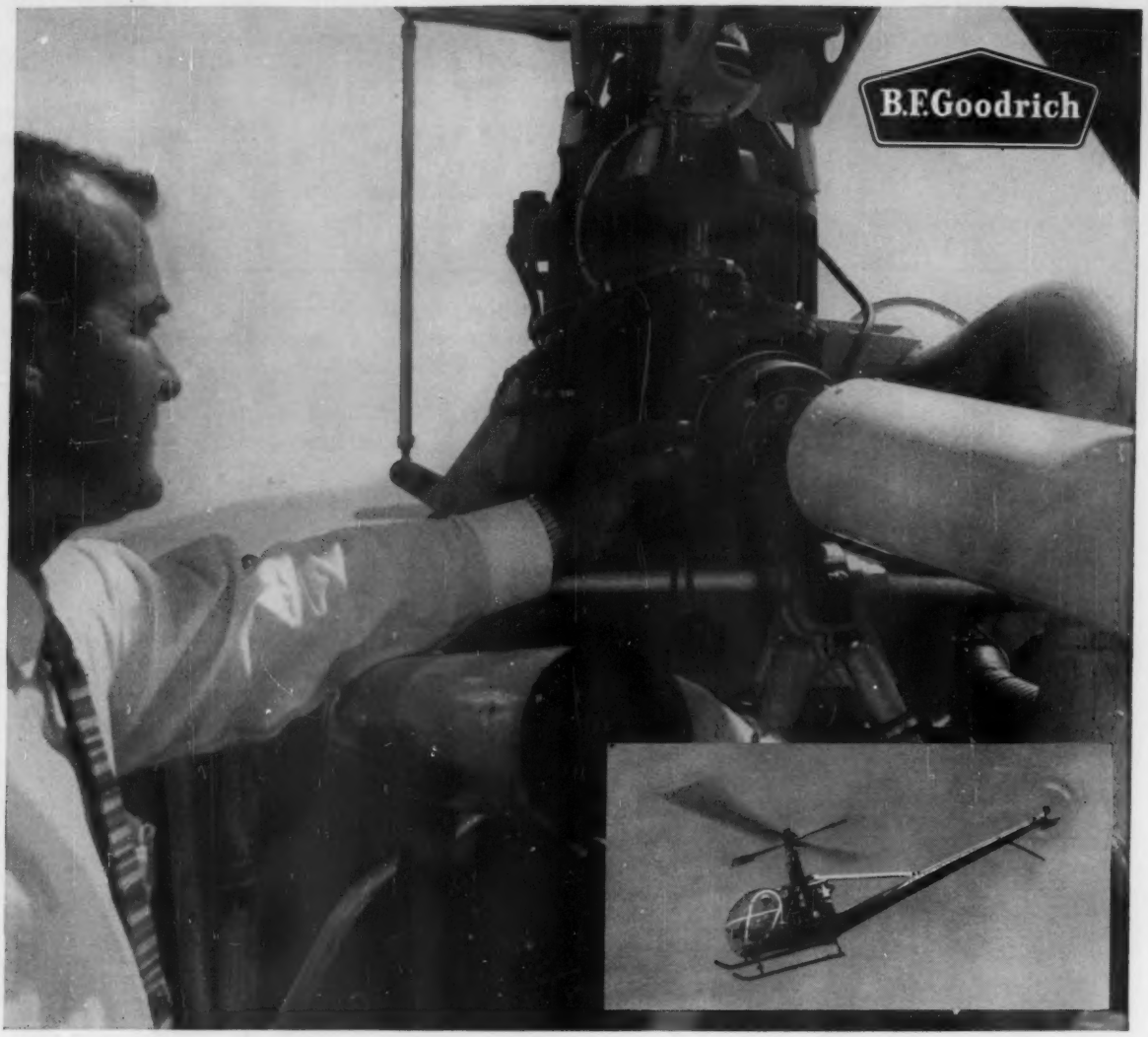

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EDITORIAL

Lessons of Lunik

There are many lessons this country can learn from the spectacular Soviet impact of Lunik on the moon as the first man-made object to bridge the 237,000 mi. gap between that planet and the earth. First, sincere congratulations must be extended to all the Soviet scientists participating in the project for a truly magnificent technical performance and the creation of a major historic milestone in space technology.

One of the lessons to be learned is that the official "sour grape" statements emanating from Vice President Nixon, Sen. Styles Bridges (R.-N.H.) and Herbert York, Defense Department director of research and engineering, are distinctly out of fashion in view of the three Soviet space technology firsts with Sputnik I, Mechta and Lunik. These scientifically unsound and politically immature denigrations of genuine Soviet achievements create a decidedly unfavorable impression in the international scientific community and win no friends for our cause. Then, too, even these official apologists for our badly lagging space technology are beginning to get pretty threadbare and implausible in their excuses.

The second lesson we should learn from Lunik is that with our officially indifferent, chronologically late and financially anemic start in space technology we cannot swiftly catch the soaring Soviets with a legislative act, a half billion dollars and some spectacular but scientifically barren jackanapes such as Project Score. We still face a long hard pull to pull abreast of Soviet space technology, and we will never do it at the current rate of federal financing and congressional apathy toward the National Aeronautics and Space Administration program.

We can expect the already torrid political temperature within NASA to grow considerably hotter as a result of Lunik. We can expect considerable pressure from the public and the same irresponsible congressmen who slashed its Fiscal 1960 budget for all sorts of drastic but scientifically insignificant action. This probably will range from demands for the scalp of NASA Administrator Keith Glennan through a variety of organizational changes to the inevitable "publicity" space shots to gloss over our genuine scientific problems. Virtually everything will be urged except the things that can really help —a more realistic budget, consistent legislative support and top-level national leadership crystallizing our need and determination for superiority in the new technologies that are the key to future power.

Let's face facts for a change. Keith Glennan and the NASA were given an impossible task when they were put into the space technology business nine months after Sputnik I went into orbit and then given a significant budget cut before their programs even had a chance to get off the ground. NASA certainly has its problems including some sharp inter-agency and intra-mural battles over specific projects, a tendency to harden its bureaucratic arteries while the agency is still in its technical infancy and the overriding task of trying to organize and recruit administratively while driving ahead technically at forced draft. Also, it will be hard for NASA to escape the inevitable invidious comparisons between the Soviets getting Lunik to the moon and its achievement in splashing the Mercury astronauts and their wives on the covers of Life magazine in the same period.

Keith Glennan sounded a courageous and realistic warning last month several weeks before Lunik that this country "is not nearly as far advanced in space technology as we had thought or hoped." Speaking at the University of California in Los Angeles (AW Aug. 31, p. 26), the NASA chief noted that:

"There seems to be a contest going on in this country in which substantial numbers of people are attempting to outdo each other in predicting exotic accomplishments in space during the next few years. In my opinion, there is need for more common sense and good judgment to be injected into this picture."

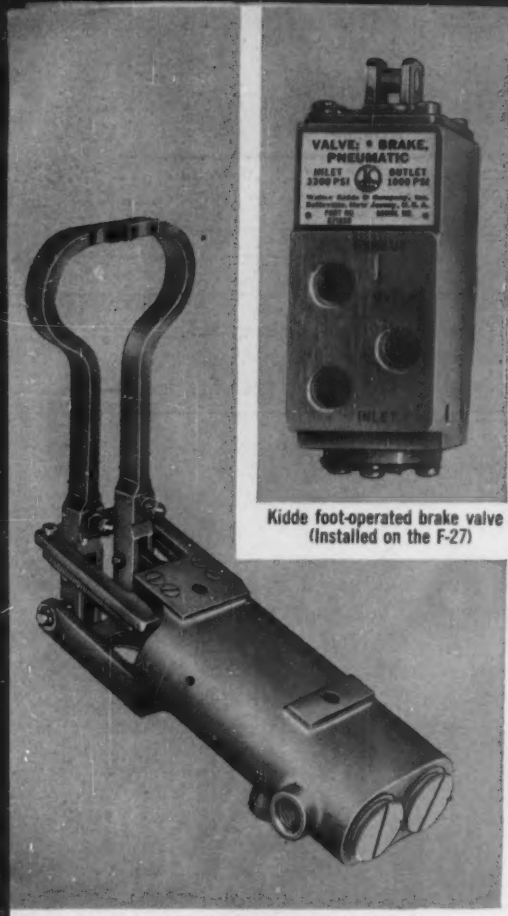
With this opinion we heartily concur.

Mr. Glennan pointed out that thus far NASA has been largely confined to completing International Geophysical Year projects conceived in that dismal period when nobody in our top national leadership could visualize any importance in space technology. For the future, NASA has only been able to plan and organize programs, as pointed out in detail in AVIATION WEEK's June 22 special report on the subject, that cannot come to fruition for several years. In the meantime, however, this country has made some solid scientific contributions to space technology with the radiation belt data gathered by the Explorer and Pioneer series and the current high quality input from the "paddlewheel" Explorer VI.

The biggest lesson we should learn from Lunik is that there are no spectacular easy short cuts to genuine achievement in space technology. No matter what we do now, we still face the prospect of several more years of tough sledding in this field before we can hope to achieve the eminence we desire. In the meantime, we need to eliminate pointless and time consuming congressional investigations, Sunday supplement predictions by the soap salesmen of space and the search for a goat on whom to attach the blame which all of us must share.

We need to support the people in the military services, industrial research organizations and NASA who are working hard to build the foundations for a truly effective space technology in the future, fight for adequate funds to support their programs and arouse public opinion to the need for continuous and consistent support for development of the technologies that will unlock the secrets of our future.

—Robert Hotz



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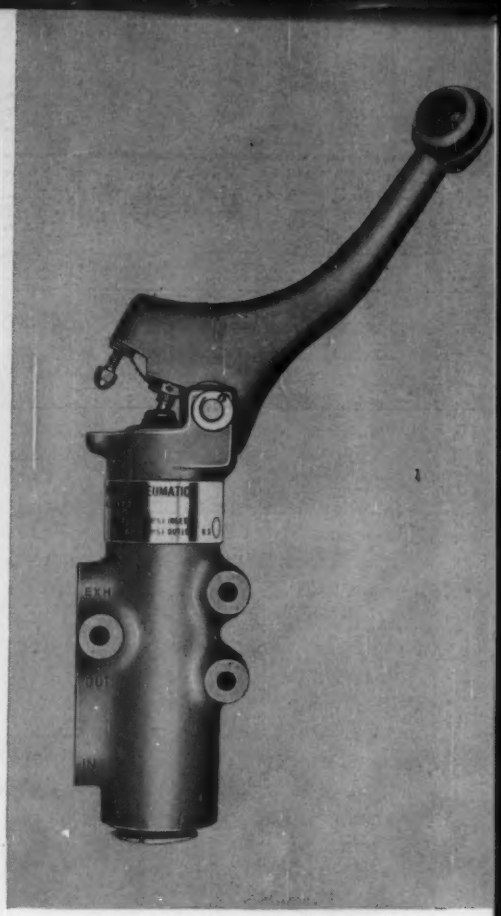

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WHO'S WHERE

In the Front Office

Noah Dietrich, board chairman of Tool Research and Engineering Corp., Compton, Calif., formed in August as a successor to three existing businesses. Other new directors: **Dr. Theodore von Karman**, chairman of the Advisory Group for Aeronautic Research and Development, NATO; **Eugene H. Catron**, partner, Shields & Co.; **William L. Davis**, vice president-engineering, Emerson Electric Co.; **H. W. Jamieson**, president, Jamieson Laboratories; **Emmett T. Steele**, formerly manager-military sales, Hughes Aircraft Co.

David A. Hill, president, Santa Barbara Research Center, Santa Barbara, Calif., a subsidiary of Hughes Aircraft Co.

Donald C. Duncan, president, Pacific Electronic Controls Corp., Monrovia, Calif., a subsidiary of Royal Industries, Inc.

Charles Weyl succeeds **Ernest Searing**, retiring, as board chairman of International Resistance Co., Philadelphia, Pa. **Walter Ware Slocum** succeeds Mr. Weyl as president.

L. R. Hackney, president, and **Eric K. Holdsworth**, vice president, Hackney-Airlift Associates, Inc., San Gabriel, Calif., newly formed technical development service in air cargo and general logistics.

Ralph W. Morrison, executive vice president, the Firewel Co., Inc., Buffalo, N. Y., a subsidiary of the Aro Equipment Corp.

Richard E. Krafve, executive vice president, Raytheon Co., Waltham, Mass. Also: **Homer R. Oldfield**, group vice president-electronic components and devices.

Defense Electronic Products of Radio Corporation of America, Camden, N. J., has announced the following appointments: **Walter G. Bain**, vice president and general manager, Communications and Missile Electronics; **Harry R. Wege**, vice president and general manager, Missile and Surface Radar. **Richard E. Posthauer** succeeds Mr. Bain as manager of the Washington, D. C., office for Defense Electronic Products.

Curtis B. Hoffman, vice president-electronics, Clevite Corp., Cleveland, Ohio. **John H. Harris** succeeds Mr. Hoffman as general manager of the Brush Instruments Division.

Honors and Elections

Howard T. Markey, Chicago lawyer, a brigadier general in the Illinois Air National Guard and a former jet test pilot, has been elected president of the Air Force Assn. for 1959-60 succeeding **Peter J. Schenk**, of Raytheon Corp. Also elected AFA officers: **Julian B. Rosenthal**, board chairman; **George D. Hardy**, secretary; **Jack B. Gross**, treasurer (re-elected).

The Air Force Assn. also presented the following honors during the National Convention and Aerospace Panorama:

Gen. Thomas S. Power, Commander in Chief of the Strategic Air Command, was named Aviation's Man of the Year for bringing his command to a new level of war-deterrent toughness, and was presented the AFA's H. H. Arnold Trophy.

(*Continued on page 127*)

INDUSTRY OBSERVER

► National Aeronautics and Space Administration is studying feasibility of installing a spectrascope in a satellite to measure infrared radiation in an extremely narrow region near 15 microns for the purpose of obtaining vertical temperature distribution data on the earth's atmosphere. Theory of using a spectroscope for this purpose has been advanced by Dr. Louis Kaplan of Massachusetts Institute of Technology.

► **Bid date for industry proposals on lightweight weather radar for meteorological satellite (AW Aug. 17, p. 61) will be extended to mid-October by National Aeronautics and Space Administration as a result of an amendment to the original work statement which is going out to industry this week. Approximately 40 companies have indicated possible interest in bidding.**

► Eight aircraft and avionics firms have submitted proposals for Air Force's Airborne Long Range Input (ALRI) program to convert RC-121D aircraft equipped with AN/APS-95 airborne radar to feed target information directly into the SAGE air defense system for guidance of long-range interceptors and Bomarc missiles (AW Aug. 10, p. 23). Companies include: Bendix Aviation, Boeing, Burroughs, General Electric, Hazeltine, Hughes Aircraft, Litton Industries and Lockheed. Air Force hopes to start negotiations with successful bidder by Oct. 20.

► **Intercontinental version of the Thor intermediate range ballistic missile is being pushed by Douglas Aircraft Co. Missile, a basic Thor plus an added stage, has been designated Thoric.**

► National Aeronautics and Space Administration's passive communications satellite program using inflatable metalized spheres has been designated Project Echo. American Telephone & Telegraph Co. will be responsible for conducting satellite communications tests under a contract signed last week with NASA.

► **Scientists at the University of Manchester in Manchester, England, have discussed with U. S. space officials, on an informal basis, the possibility of including British instrumentation in the Thor-Delta space vehicles now being built for NASA by Douglas Aircraft Co.**

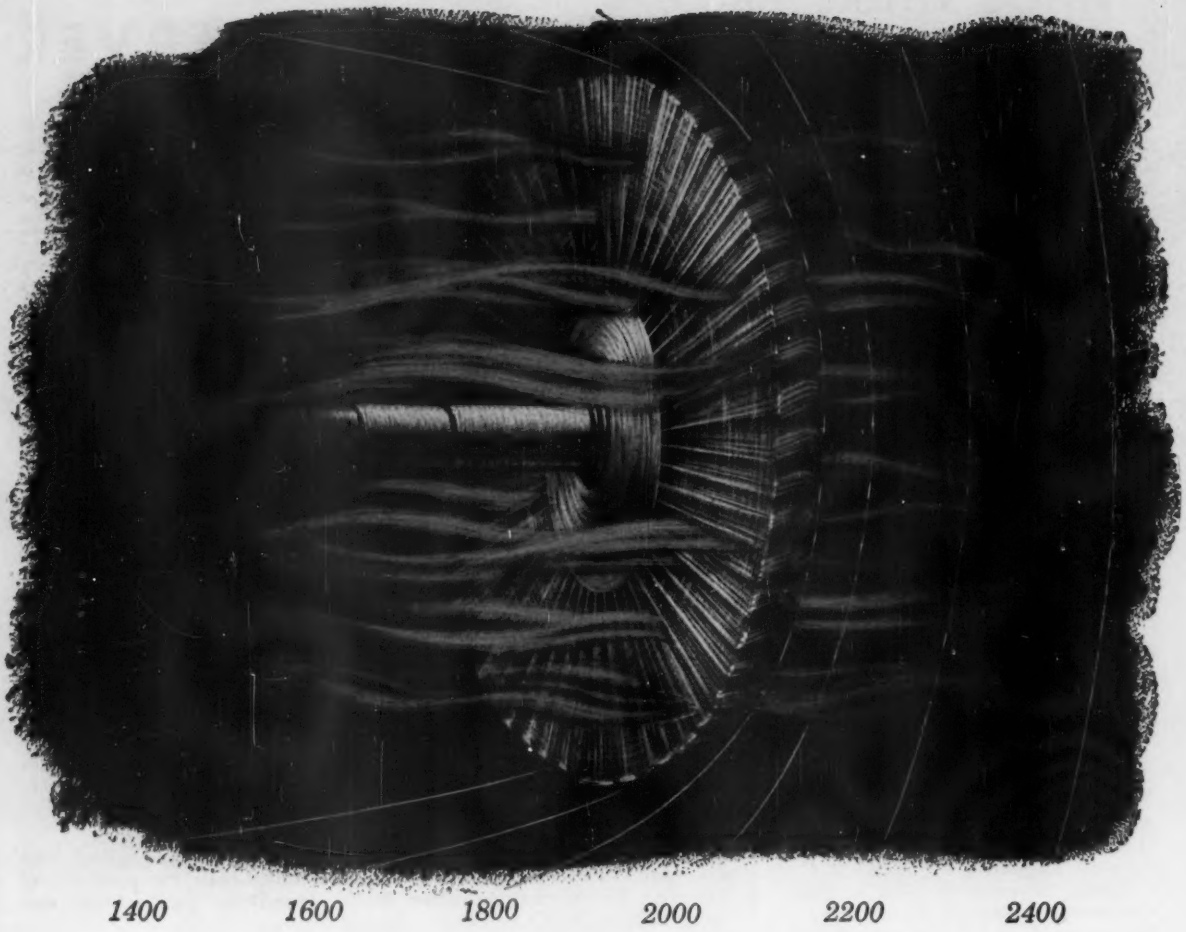
► Diode reliability study for the Minuteman solid-propellant ICBM program is being made by Pacific Semiconductors, Inc., under subcontract to North American Aviation's Autonetics Division, prime contractor for the guidance system. Large number of diodes will be used both in missile guidance system and ground programing units.

► **Army Ballistic Missile Agency has awarded a contract for the study of possible acoustic vibration problems in connection with launching of a 1.5 million lb. thrust Saturn vehicle. Vibration levels in the range below 100 cps. may prove to be a severe design consideration in launching pad design as well as in the choice of land on which to locate the pad. Studies in connection with the Nova vehicle with its six 1.5 million lb. thrust booster chambers are scheduled to be conducted later.**

► Certain test stands at the Martin Co.'s Denver facility where Titan ICBM static tests are conducted could be used for operational launchings in the event of war. Stands, however, could withstand only a single launch which would be made only as a last-minute emergency measure.

► **First production model of the Lockheed P3V, Navy patrol-plane version of the Electra turboprop transport, is scheduled to make its first flight in November using Allison 501-D25-10W constant speed engines rated at 4,500 eshp. Aircraft's maximum takeoff weight will be 125,000 lb., with a normal fuel load of 9,200 gal. of fuel.**

► First Atlas ICBM fired earlier this month by Strategic Air Command crew from Vandenberg AFB, Calif. (AW Sept. 14, p. 32), impacted in the Pacific Ocean near Wake Island within one-mile radius of the target point located 4,480 mi. from the launch point.



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Washington Roundup

McNeil Resigns

Wilfred J. McNeil, controller of military finances since the Defense Department was established in 1947, resigned last week as Assistant Secretary of Defense (comptroller). McNeil will leave the Pentagon on Nov. 1 to become president and chief executive officer of Grace Lines, Inc., and a director of the parent W. R. Grace & Co. McNeil told President Eisenhower that "personal considerations now compel me" to resign. Eisenhower praised McNeil's work and said he is "thankful also for the technical changes you have recently carried through to improve the future budgetary and fiscal operations of the Department."

In another move, J. Vincent Burke, Jr., was sworn in last week as general counsel of the Defense Department. A former Pittsburgh attorney, Burke replaced the recently-resigned Robert Dechert.

Bahama Entertainment List

Names of top-ranking military officers and defense officials entertained by the Martin Co. at the Eleuthera Club in the Bahamas and demanded by a House Armed Services Subcommittee probably will not be disclosed. George M. Bunker, Martin chairman of the board, furnished the names to a closed session of the subcommittee investigating allegations of a "munitions lobby" (AW Aug. 24, p. 33).

Martin said the company wants the subcommittee to release the names. Rep. Edward Hebert (D.-La.), subcommittee chairman, refused, pointing to the rule of the House of Representatives which states that testimony shall be given in executive session if it "may tend to defame, degrade or incriminate any person." Hebert said:

"If Mr. Bunker believes that making public Martin Co. guest lists would not tend 'to defame, degrade, or incriminate' any of the persons he named to executive session, he should have no hesitancy in telling who attended any parties in the Bahama Islands, in Washington, or any place else. He may tell who went, what they did, why they were invited and whether the objective was accomplished."

Bunker was first asked to supply the guest list on Aug. 13, then he was subpoenaed to produce it at a 9 a.m. subcommittee session Sept. 10. Bunker explained that he had made "every reasonable effort" to obtain the information from Eleuthera, but was unsuccessful because the club recently changed management and was closed during the summer months. The list given the subcommittee, he said, was drawn from recollections of who the guests were on eight occasions during the past three years.

Bunker declared "that there has been no violation of business or political or military ethics that I know about in the relationships between the government and private industry in the current defense program. It has been too grim an affair for energies to be diverted from the supreme goal we must achieve. There can be no excuse for unethical practices, and to my knowledge there has been none."

Russian Airlift From Moscow

Russian turbine transports which carried Premier Nikita Khrushchev and the Soviet party to the U.S. reached Andrews AFB near Washington with less than one hour fuel reserves, according to American observers on the flights. Tu-114 carried Khrushchev nonstop from Moscow to Washington, but the Tu-104 and Il-18 which carried the Russian press and the rest of the official party both were routed via London, Keflavik and Gander. Fighting headwinds, the Tu-114 arrived 51 min. late, and the Tu-104 was 19 min. late. Earlier, the Il-18 made the three-stop trip 16 min. behind schedule.

Soviet Tour Airlift

Following the official reception in Washington, Soviet Premier Nikita Khrushchev and his party are touring the U.S. in three Air Force VC-137 transports, military counterpart of the Boeing 707. Baggage is carried in a KC-135 jet tanker. State Department has chartered a combined turbine and piston engine airlift for the group which is traveling with the Russians. Trans World and American Airlines each furnished a 707 and American supplied a DC-7 for the New York-Los Angeles trip. Between San Francisco and Des Moines, Continental Air Lines will fly a 707, United Air Lines will operate two DC-7s and American will fly a third DC-7. The same aircraft will be used on the Des Moines-Pittsburgh trip. The Pittsburgh-Washington schedule calls for four aircraft–DC-7s from American and Pan American and Super Constellations from TWA and Eastern Air Lines.

Soviets Seek Air Rights

In Washington, Khrushchev confirmed USSR interest in exchanging commercial air rights with the U.S. in his National Press Club luncheon speech. In response to a question, he said the Soviet Union wants a commercial aviation bilateral agreement with the U.S. but that he considers it a "minor problem" that can be easily handled at lower diplomatic levels. Khrushchev said he did not plan to include commercial air rights in his foreign trade talks with President Eisenhower.

More Airline Partnerships?

Trend to joint operations by international airlines is spreading to South America as carriers try to strengthen their competitive positions in the growing jet service market. Officers and directors of Aerovias Nacionales de Colombia, the Colombian line, and Linea Aeropostal Venezolana, the Venezuelan line, have conferred during the past two weeks in Bogota and Caracas on a possible partnership to meet the strong competition of foreign carriers operating jet service to Latin America.

Leopoldo Correa Sanchez, president of LAV, left on a trip to Peru, Chile, Argentina, and Brazil last week to study in detail the organization of the airlines of these countries and discuss the possibility of their joining an LAV-Avianca partnership. This move is also in line with the general trend toward close economic cooperation among Latin American countries.

FAA Fund Shift

Federal Aviation Agency was given authority to transfer $17 million from one budget category to another in the closing hours of Congress last week to enable it to staff new air navigation facilities as soon as they are ready for operations. FAA plans to transfer the funds from "establishment of air navigation facilities" to "expenses."

—Washington staff

Von Karman Urges Flexible War Posture

Short-term nuclear war plans, limited war neglect termed major strategic errors in exclusive report.

By J. S. Butz, Jr.

Washington—Planning for a short-term nuclear war represents a major strategic error in the opinion of Dr. Theodore von Karman, who believes that any total thermonuclear war will be fought on a long-term basis. Neglect of limited war capability while planning for all-out nuclear warfare also is a major error in von Karman's view. He believes the U. S. should maintain a variety of weapons and forces to be prepared for a variety of military threats.

Von Karman outlined these basic concepts in an exclusive interview with AVIATION WEEK in which he detailed his views on U. S. airpower policy over the next decade. Although von Karman has been an adviser to the Air Force for 20 years, there has been no major expression of his views printed since he wrote his classic report for General of the Army H. H. Arnold in 1945 entitled "Toward New Horizons." This report was the blueprint for post-war organization of USAF research and development programs.

Forecast of a long-term all-out war stems from Dr. von Karman's belief that the most massive thermonuclear attack cannot completely destroy the military forces and economy of a large industrial nation such as the U. S. or the Soviet Union. Both countries are spread over large land masses, and von Karman feels that they present too many necessary targets for an aggressor to destroy over a short period of time.

Retaliation Capability

Since the war-making potential of neither country could be knocked out in an initial massive attack, von Karman believes both could absorb an initial attack, even of the magnitude projected for total nuclear war, and still retain the capability of retaliating and continuing the struggle. Thus, a nation planning for a war that would be over within a few weeks or months could be caught without the means to support a long war and eventually lose despite the success of the initial nuclear attack.

In the same way, von Karman feels it is a major mistake to concentrate solely on total war and neglect preparations for limited warfare since such planning puts "all the eggs in one basket." Concentration on all-out warfare limits the types of action a nation can fight, and it violates the basic principle of flexibility that he feels should apply to any planning operation.

Von Karman believes the philosophy of flexibility is particularly applicable to a war situation, regardless of the type of weapons involved, and that it is necessary to develop a variety of weapons and maintain the power to handle a number of different contingencies.

Development of military airpower to fit this philosophy should include these major factors, in von Karman's view:

- **Improve USAF transportation** capability, including the production of a large force of modern transport aircraft, to provide the flexible types of airlift essential in any kind of war.
- **Strengthen Tactical Air Command** to provide strong air support for limited war capability.
- **Emphasize development** of VTOL aircraft which would be needed if normal airfields were destroyed and which would provide excellent platforms for tactical reconnaissance.
- **Increase reliability and accuracy** of large ballistic missile systems and cut costs by developing manned first stages powered by air-breathing engines. Von Karman believes that recoverable first stages are attractive and may be mandatory for future missile systems.

To satisfy the basic precept of flexibility, von Karman believes aeronautical planning for the foreseeable future must include parallel development of manned aircraft and missiles. This approach retains the freedom of action implicit in man's power to reason—a facility, von Karman believes, that computer systems will not be capable of duplicating for many years. This human facility is particularly important in reconnaissance missions where on-the-spot interpretation of target information is vital to the success of any type attack.

Von Karman sees the human role as an irreplaceable element in forward observer systems for strategic and tactical attack missions, even though new equipment will become available to reinforce man's senses and aid in decision making.

Main problems in the development of manned aircraft which will reach orbital speeds and travel in and out of the atmosphere may be concerned with providing satisfactory automatic control devices. Von Karman said this also applies to winged orbital aircraft flying in the Mach 25 region which will have severe high temperature problems during re-entry.

Since development and production of advanced weapon systems has moved past the billion-dollar cost level, von Karman recognizes that advocating a wide assortment of weapons carries with it the responsibility of finding ways to cut cost. In this area, he proposes an active program to trim some of the bureaucratic bulk out of the current industrial, military and government structures.

Engineering productivity can be increased, both in industry and the military services, by working harder, von Karman says. He feels that the great majority of engineering forces are not now making full use of their time and talents.

National Goals

On a broader scale, von Karman believes that some way must be found to increase the nation's sense of purpose by creating and defining clear national goals. He contends that the increased effort needed from the ordinary citizen will not be made unless a sense of urgency is created through clear, strong statements of U. S. problems and goals from the top level of government. Von Karman thinks the U. S. is in the midst of a technical crisis of which the people are not aware, despite warnings from such military and scientific leaders as Vice Adm. Hyman Rickover and Edward Teller.

Turning to specific Air Force problems, von Karman says there are three management areas where fundamental changes must be made before USAF equipment, personnel and doctrines can stay abreast of scientific progress at minimum cost. These requirements are:

- **Research programs must be** operated on a continuous basis, and money should be allotted for entire programs in place of present annual funding practices.
- **Air Force technical** and scientific officers must be allowed to spend a practical length of time on their technical jobs, particularly in technical management posts, rather than being rotated in the standard short military duty tours.
- **Control of research** and development programs should be on the working level rather than high policy levels

Space Technology

that are removed from the actual project.

Major drawback in the present annual funding approach to research programs lies in the fact that all money provided for a given fiscal year must be spent in that year. Von Karman points out that, if a program has fallen behind its planned pace, its manager is not permitted to apply surplus funds to the next year's budget, even if he knows that the pace of the project will be accelerating. The money must either be turned back to the Treasury Department or spent hastily for work which may not prove necessary to the project as it develops. Von Karman says that he views this latter procedure, which is in extensive current use, as a detriment to both government and industry.

A second major drawback to annual funding is the fact that it keeps research managers from their technical business for at least three months of the year while they justify their programs and prepare the annual budget. Von Karman estimates that this factor increases the time required to complete a given project by at least 25%.

Retaining program control at high policy levels is another philosophy von Karman thinks causes unnecessary delay because working level personnel are constantly required to report on every phase of a product. He believes that once a policy decision has been made to establish a program, detailed authority should be passed to people on the "competent" level where the actual work will be done. If these people are competent enough to be chosen to do the work in the first place, he says, their policy chiefs should be able to trust their final project report without insisting upon continuous detailed review as work progresses.

Von Karman also feels that USAF research and development personnel should have technical competence compatible with that of industry specialists and that such competence is difficult, if not impossible, to maintain under the standard military rotation system where officers spend only two or three years at each post.

Probably the most interesting aspect of von Karman's three basic recommendations for improving USAF management is the fact that he first made them 15 years ago in his report to Gen. Arnold. Since then, the continuing lack of a solution for these three fundamental problems has been repeatedly substantiated by the dozen or more groups of experts who have studied the research and development effort.

Von Karman points out that these problems cannot be solved completely by internal Air Force action. They also require legislation, as well as cooperation from higher civilian authority within the Defense Department and Administration. Most of the reports on research and development management, and particularly the Stever Report of 1958, have stressed this point.

Top USAF officials have the responsibility for making necessary internal changes and for taking the lead in reorienting higher authority in a campaign for adequate solutions to the problems, according to von Karman. The Stever Report also strongly urged that top Air Force officials take the initiative in this area.

In his discussion of current U. S. problems, von Karman said the best research organization he has ever known was the emergency association of German science, which operated in Germany after World War I. It was financed largely by funds donated by industry, and the companies shared equally in the results of the research. Contributing industrial groups felt it was in the national interest to keep persons with demonstrated scientific ability active in their field, as well as to train student scientists.

In their requests to the association for financial support, scientists were required to state what work they intended to follow, how much new equipment they would need, how many men would be required and how long the project was expected to last. Each scientist then proceeded with his grant of money, and he was not required to make reports or be reviewed during the intermediate phases of his work. The scientist returned to the association only when his work was completed or he ran out of funds, or if new information made it impossible or inadvisable to continue.

Von Karman said the vast majority of scientists involved proved to be reasonable in their requests for funding and careful and conscientious in handling the money they were given. He feels this would be true of the majority in any group of people who have assumed a responsibility and are given control over their actions.

'Troubled Conservative'

Dr. Theodore von Karman's scientific career extends over the entire history of heavier-than-air flight, and his contributions to aviation range from developing major elements of the mathematical basis for gas dynamics theory to providing policy and management counsel to the Air Force. Since 1951, he has been chairman of the Advisory Group for Aeronautical Research and Development of the North Atlantic Treaty Organization, an organization that has achieved a high degree of technical cooperation and is used as a model for other NATO scientific groups.

Von Karman received his degree in mechanical engineering from the Royal Technical University in Budapest, Hungary, in 1902; his doctorate from the University of Goettingen, Germany, in 1908. Von Karman, who came to the U. S. in 1926, has been awarded 22 honorary doctorates and 15 major scientific medals, honors which give him a distinctive position in aviation.

Von Karman's view of himself as a "troubled conservative technically and politically" sets the perspective for his views of current and future trends. His concern stems from a belief that conservatism is keeping the Western world from realizing its potential and taking advantage of its opportunities in a number of vital areas.

Destruction of Jupiter Aborts Biological Test

Washington—Space environment test of a variety of biological subjects was aborted last week when the Army-Chrysler Jupiter intermediate range ballistic missile carrying them was destroyed shortly after launch.

National Aeronautics and Space Administration biological payload was carried in the Jupiter nose cone on a scheduled IRBM test flight. The Jupiter was destroyed from the ground at an altitude of about 1,000 ft. above the pad after the missile began to wobble in flight.

Biological specimens would have experienced about nine minutes of weightlessness during the 1,500 mi. Jupiter flight. They also would have been subjected to varying forces and to cosmic radiation. NASA plans another attempt to send this collection of biological specimens on a ballistic missile flight within the near future.

Radiation experiment subjects included 14 pregnant mice, mold spores, a human intestinal bacteriological sample, onions and mustard seed and fruit fly larvae. Two frogs were included to study radiation, acceleration and other effects, and human skin and blood were also carried.

Soviets Hit Moon, Data Flow Improves

By Evert Clark

Successful launching of an 858.44-lb. instrumented payload to the surface of the moon by the Soviet Union was accompanied by the release of an unprecedented amount of information, raising hopes that Russian scientists may be allowed freer communication with their Western colleagues in the future.

Placing of the first man-made object on the moon coincided with the arrival in the U. S. of Soviet Premier Nikita Khrushchev and a campaign by the Soviet government to make a number of gestures toward greater international cooperation. Khrushchev termed the timing "a simple but pleasant coincidence" and said the launchings are too complex to be timed for political reasons.

The payload (see p. 30) impacted on the moon at 5:02:24 p.m. EDT Sept. 13, in a triangular area bounded by the Seas of Tranquility, Serenity and Vapors, according to Soviet scientists. This, they said, was some 125 to 185 mi. off the intended target.

The capsule was launched some 35 hr. earlier by a multi-staged rocket. It separated after burnout from the final stage, which was guided and weighed 3,324.2 lb. without fuel. Statements by Soviet scientists indicated the launching rocket had at least three stages and probably used a cluster of engines in at least the first stage.

Both the rocket and capsule were decontaminated before launch. A sterilization device also was carried inside the capsule, according to the Soviets. Contact with the moon was supposed to switch on a special mechanism which sprayed the capsule with a disinfecting solution.

Russians said the capsule's velocity was about 7,603 fps. approximately five hours before impact when it was entering the area where the moon's gravitational field would be the dominant force affecting its motion. Speed at the moment of impact, they said, was about 10,877 fps.

The capsule carried a "moon altimeter"—a special radio circuit that was to switch on a few moments before impact to supply additional data on the changes in the rocket's altitude relative to the moon's surface. Signals were to be telemetered on 183.6 mc.

Considerable fading of signals from the transmitter in the rocket's last stage left some initial doubts among Russian scientists about the fate of the final stage, but at least one Western tracking station reportedly tracked on the last stage transmitter frequency to the time of impact.

Most successful Western tracking was done by an Air Force Ballistic Missile Division–Space Technology Laboratories team working in conjunction with the University of Manchester's Jodrell Bank station in England. The British group, headed by Dr. A. C. B. Lovell, provided the 250-ft. steerable radio telescope and did the actual tracking, while the BMD-STL group manned special trailers and provided steering coordinates.

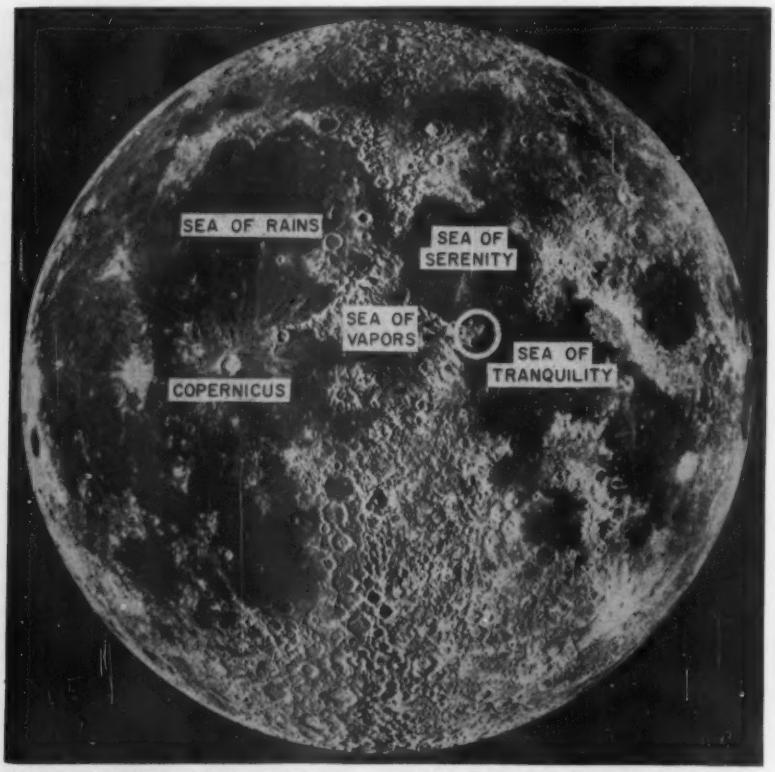
Lovell was in the midst of the process of bouncing signals off the planet Venus when the lunar shot was announced. A combination of cooperation from Soviet scientists, who sent Lovell steering coordinates for the Jodrell location, and trajectory predictions from the BMD-STL computing center in Inglewood, Calif., allowed the station to track for several hours after launch on Sept. 12 and for several hours preceding the impact on Sept. 13.

Acceleration Data

A Jodrell Bank spokesman told AVIATION WEEK that acceleration data gathered by the telescope showed a rapid increase in acceleration of the probe in its last hour of flight. This reached a final value in very close agreement with the theoretical value for a freely falling body at the surface of the moon. At the moment of impact, the telescope was aligned directly with the moon.

Coordinates provided by the Soviets were "astonishingly" accurate and were supplied in two separate telegrams that gave half-hourly azimuth and elevation positions for the probe over the two periods in which it would be visible from Jodrell. Although the Soviets changed their initial prediction of impact time some four hours before the impact occurred, they did not notify Jodrell of the change. The initial prediction was only 136 sec. off the impact time announced later, and the last prediction was off by only 84 sec.

This was the first time that Russia has provided Jodrell with specific tracking information. Experts at Jodrell believe the Russians previously thought that the telescope's beam was wide enough to pick up satellites unaided.



SOVIET UNION'S 858.44-lb. instrumented payload is believed to have struck the surface of the moon approximately in the circled area between the Seas of Tranquility, Serenity and Vapors. Probe was tracked by Western observers. Soviets put time of impact at 5:02:24 EDT Sept. 13. Moon's north pole is at top of this photo.

The Jodrell spokesman said the coordinates supplied by the Russians agreed precisely with the scan position obtained by the telescope on the basis of maximum signal strength received. Russia also notified other countries of the shot roughly six hours after launching through the World Warning Center, Fort Belvoir, Va. The only other launching in which they informed the center was Sputnik III.

Only modification to the telescope was to choose a dipole aerial and reflector at the focus of the dish of a size dictated by the probe's transmitting frequencies.

Jodrell telescope tracked on both the 19.993 mc. and 183.6 mc. frequencies of transmitters in the payload, and apparently it also tracked for a part of the time on the 20.003 mc. frequency of the transmitter in the rocket's final stage.

Others reporting successful tracking for at least short intervals were MacKay Radio at San Francisco, Calif., on 20.003 mc,; a Japanese station for 90 min. on 19.997 mc.; Army Signal Corps Laboratories at Ft. Monmouth, N. J., for about six and a half hours in midflight on two frequencies. The impact came about four or five minutes before the probe would again have come within the view of the 60-ft. Ft. Monmouth dish.

Soviet scientists and Premier Khrushchev disputed Vice President Richard Nixon's statement that they had three failures in the two weeks prior to the successful launching. They said there had been "no false starts." There were other indications that three shots did precede the lunar strike, but that they were in the nature of supporting shots for the lunar mission rather than failures in attempts to hit the moon.

Dr. Herbert York, Defense Department's director of research and engineering, speculated that the launching rocket may have had a first-stage thrust as high as 600,000 to 800,000 lb. Soviet scientists refused to give details on the launching vehicle.

However, Prof. Yuriy Krylov, discussing on Radio Moscow the "sort of engines the rocket must have to ensure the necessary speed" for a moon shot, said "the rocket is multistaged with several engines in several compartments. . . . as the fuel is expended one stage after another drops off. . . ."

General principles for designing rocket engines, Krylov said, require the use of "high caloric fuel" burned under the highest pressure possible. "Practically this should produce engines working under a pressure of 50 to 100 atmospheres and at a temperature of 5,450 to 6,330F.

"Such powerful modern rockets as the American Atlas usually have several engines, since it has not yet proved possible to design a combustion chamber capable of developing a thrust of several hundred tons."

Use of several engines together creates "a great many difficulties," Krylov said. "They must be well coordinated and must receive exact doses of fuel. It is especially important to make sure that the engines of each stage of the rocket are cut off exactly when they should be.

"Everything depends on the degree of exactitude with which the rocket develops its designed velocity and with which the direction of flight is maintained up to engine cutoff. It is impermissible to make a mistake of even half a hundredth of one per cent."

Speaking specifically of the lunar shot, Academician Leonid Sedov, head of Russia's spaceflight group within the Academy of Sciences and new president of the International Astronautical Federation, said acceleration had to be maintained to within one meter per second, the angle to less than one degree and the launching time to within a few seconds of calculated time. He said the guidance system used was common to all Soviet rockets and was used to control all stages of the rocket, including the final one. The capsule itself was uncontrolled.

Boris Kukarkin, vice chairman of the Academy's astronomical council, said the sodium cloud released by the probe early in the flight was photographed by observatories at Tbilisi, Byurakan, Stalinabad, Ashkhabad, Alma Ata, Odessa and other locations.

The Ambastuman Observatory in Georgia obtained a photograph of the rocket itself at a distance of 78,000 mi. an hour and a half before the cloud was created, Radio Moscow said. Kukarkin also said Alma Ata, Byurakan and Crimean observatories had obtained photos of the rocket.

Astronomer Nikolai Barabashev wrote in the magazine Trud that scientists of Kharkov Observatory "observed a certain light effect at the moment of the Soviet lunar rocket's impact on the moon . . . exactly where it was expected to occur.

"The nature of this light effect, its connection with the rocket's landing,

Soviet Moon Theories

Moscow—Soviet scientists believe that the moon may have oil and gas deposits, that parts of its surface are periodically covered with something like a light hoar frost or a short-lived lower species of vegetation and that its craters may be of volcanic origin.

These theories were discussed over Radio Moscow's home service broadcasts by V. Komarov, astronomer and Moscow Planetarium lecturer, in connection with the successful impact of a Soviet rocket on the moon:

- **"It has been proven by Professor Markov, the Soviet scientist, that the whole lunar surface consists of porous matter of spongy structure," apparently due to meteorite bombardment.**
- **Detailed investigation of the 80-mi. dia. Alfonso Crater by means of a giant reflector-telescope of the Crimean Astrophysical Observatory produced pictures which showed a "flare" of reddish color and considerable brilliancy at Alfonso's central peak. This was observed both by Prof. Kozyrev and by a researcher named Yezersky of the Kharkov Observatory. They succeeded in establishing that the escape of carbon, "a typical feature of volcanic processes," took place at the time of the flare.**
- **Kozyrev's discovery shows that the moon might contain numerous deposits of natural gas and, therefore, oil deposits can be expected. "If the hypothesis of lunar gas and oil turns out to be true, it could be very important for the establishment of space stations on the moon's surface. Gas and oil would become the power resources essential for the moon's exploitation."**
- **Shortly before the full moon, the whole of a large area northeast of the ring-shaped Aritarchus and Herodotus mountains changes color from its usual ash-grey to a yellowish-green. "This is not a light color veil but a bright color of the surface itself," Komarov said. "A rather big, blurred spot appears near the middle of the lunar disk in the first quarter and last quarter periods. This spot even covers some of the mountain ranges with their summits being barely discernible. It very much resembles a shadow but still is not a shadow." These and other periodic color changes occur, usually corresponding to lunar phases or the change of the sun's height above the moon's horizon. Prof. Nikolai Barabashev believes the blurred spot is "something like light hoar frost. But some other explorers even express the view that the periodic changes of color of separate regions . . . can be linked with certain vegetative processes." These might be "short-lived lower species of vegetation which can exist in an atmosphere of carbon dioxide coming from the cracks in the bottom of some craters and pick up the nourishment it needs from the soil," Komarov said.**

Soviet Lunar Probe Performance

Soviet lunar rocket was launched at approximately 6 a.m. EDT Sept. 12. It was a multi-staged rocket with guidance in the final stage for correcting trajectory after launch. The spherical 858.44-lb. payload separated from the final stage, which weighed 3,324.2 lb. without fuel, sometime after burnout of the last stage.

The gas filled, hermetically-sealed payload carried instruments for measuring earth and moon's magnetic field and radiation belts; intensity, variation of intensity and heavy nuclei content of cosmic radiation; spatial distribution and composition of interplanetary gases; spatial distribution of micrometeorites. Temperature was maintained between 68 and 95F.

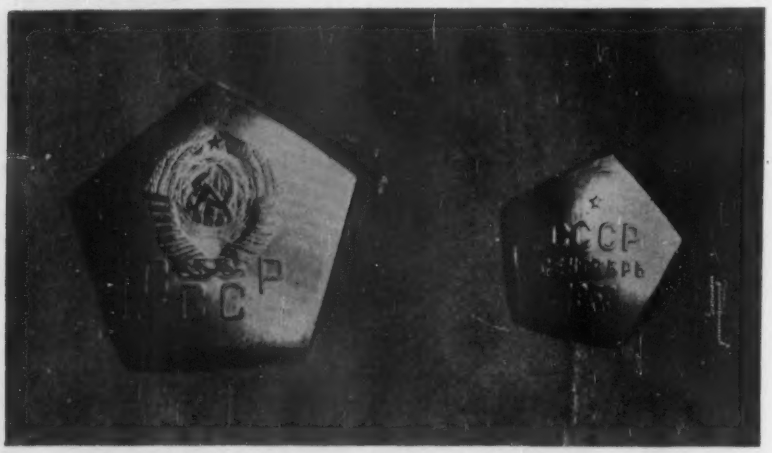
Payload carried one transmitter operating on 19.993 mc. and 39.986 mc., and another operating on 183.6 mc. Signal impulses ranged from 0.2 to 0.8 sec., with frequency of impulse repetition being one plus or minus 0.15 sec. Signals remained strong until impact.

The last stage of the rocket carried a transmitter operating on 20.003 and 19.997 mc. which emitted signals ranging from 0.8 to 1.5 sec. Signals grew quite weak in the hours during which the rocket should have been nearing the moon.

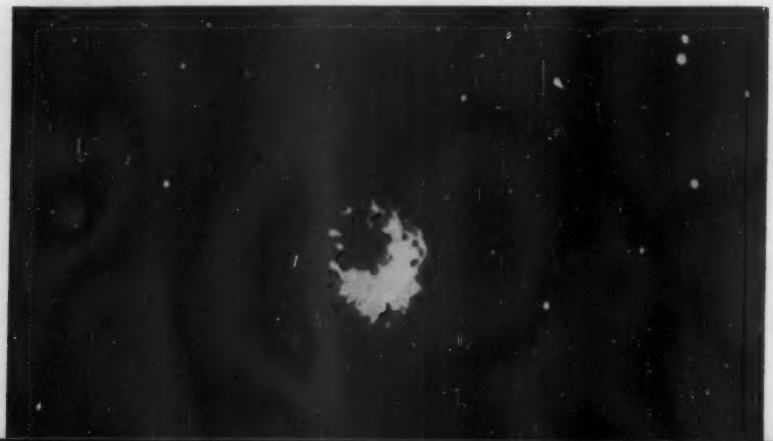
About 9 hr. after launch, the rocket emitted a sodium cloud that was photographed and observed by a number of Soviet observatories.

Payload impacted on the moon at 5:02:24 p.m. EDT Sept. 13. It carried two metallic spheres 3.54 in. in diameter. One was composed of 72 pentagonal pieces marked with the Soviet coat of arms and the inscription "The Union of Soviet Socialist Republics, September 1959." The second contained a steel ribbon 12 in. long and one-half inch wide bearing the same inscription. The final stage of the rocket may not have impacted. It carried a sphere similar to those in the capsule but 5.9 in. in diameter.

Soviets thus far have announced the launching of three earth-circling satellites weighing about 184 lb., 1,120 lb. and 2,925 lb. respectively; the Mechta payload, weighing about 797 lb., which passed within 5,000 mi. of the moon and became the first solar satellite, and the lunar impact payload. Of the earth satellites, only the third is still in orbit.



PAYLOAD and final-stage rocket carried metal emblems forming small spheres. Below, sodium released by rocket formed a luminescent cloud which reached a diameter of 360 mi. in 4 min., lasted 5 to 6 min., was bright as star of the fourth or fifth magnitude.



will be established only after careful visual and photographic observation," he said.

A great number of official statements on Radio Moscow and by Tass news agency and Soviet scientists at a post-impact press conference indicated that raw data rather than only conclusions, as in the past, may be released for the first time on this shot.

Geophysicist Yevgeni Fedorov told the press conference:

"Soviet scientists believe now that certain improvements of relations between countries of the world is setting in, notably between the U.S. and USSR, this contribution (of the lunar probe) is particularly important. Nikita Sergeyevich (Khrushchev's) visit and the talks which he will have with President Eisenhower—we are all confident—will contribute to the easing of international tension and to the extension of international cooperation. The fruits of international cooperation in science can be colossal."

In Washington, Khrushchev presented President Eisenhower with a replica of one of the frangible spheres carried by the capsule, and told him:

"We have no doubt that the excellent scientists, engineers and workers of the U.S.A. who are engaged in the field of conquering the cosmos will also carry their pennant over to the moon.

"The Soviet pennant, as an old resident, will then welcome your pennant, and they will live there together in peace and friendship."

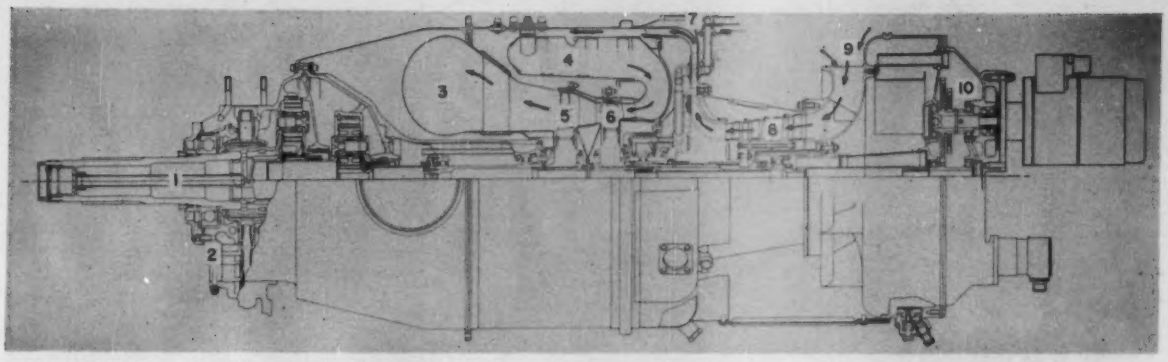
Transit I Unsuccessful In Attempt at Orbit

Washington—An attempt to launch the Transit I experimental navigational satellite into a 400-mi. circular orbit from Cape Canaveral, Fla., failed last week, apparently because the third stage of the Thor Able launching vehicle did not fire.

Transit I was a 36-in., 265-lb. non-miniaturized test vehicle, the first in a three-year program to develop an orbiting navigation aid for air and sea craft. It carried two ultra-stable transmitters, each capable of sending on two frequencies at one-minute intervals.

Six ground stations in the U.S., Canada and England were to have tracked Transit in an attempt to determine the refraction (bending) of satellite radio signals caused by their passage through the ionosphere. Unless such bending is compensated for, it would create errors in positions determined from the satellite.

Transit is an Advanced Research Projects Agency program assigned to Navy's Bureau of Ordnance, with Johns Hopkins University's Applied Physics Laboratory as prime contractor for payload.



PT-6 CUTAWAY with numbers showing 1—propeller shaft; 2—reduction gearing; 3—exhaust duct; 4—combustion chamber; 5—free turbine; 6—driving turbine; 7—diffuser; 8—three-stage axial compressor; 9—air intake; 10—accessory drive section.

Pratt & Whitney Plans 500 shp. Turbine

Montreal—Canada's first turboprop engine—a small, 250-lb. free turbine engine with a takeoff rating of 500 equivalent shaft horsepower—has been developed for use with light aircraft by Canadian Pratt & Whitney Aircraft, a United Aircraft Corp. subsidiary.

Designated the PT-6, with a power-weight ratio of 2 to 1, the engine will be produced in two versions: the 250-lb. PT6A-2 turboprop, aimed at light to medium single and multi-engine and VTOL airplanes, and the 225-lb. PT6B-2 turboshaft for helicopters.

The engine also will be adapted for marine uses, with hydrofoils, and as an auxiliary power unit for large aircraft. Export possibilities embrace the British Commonwealth nations.

Cost of the PT-6 will approximate $15,000. Studies on the engine began in October, 1958, and design details were initiated early this year. First complete hardware will not be assembled until late October at the earliest. Testing will be conducted in two cells at the company's Montreal plant.

Prototype engines will be available in 1961 (testbed flying may be accomplished on Beech E18 or Douglas DC-3). Production engines are scheduled for 1962, with the possibility of earlier deliveries depending on orders, AVIATION WEEK was told.

Design of the PT-6, which utilizes a three-stage axial compressor, permits continuous engine operation with the thrust axis inclined from 45 deg. nose down to 110 deg. nose up. Turboprop version—the PT6A-2—has a guaranteed maximum specific fuel consumption of 0.69 lb./eshp./hr. and produces 500 eshp. at 2,350 rpm. at takeoff, sea level static.

Turboshaft version—the PT6B-2—produces 500 eshp. at takeoff, sea level static, with single stage of gearing providing 6,800 output shaft rpm. Specific fuel consumption on takeoff is 0.71 lb./shp./hr.

All axial compressor blades are identical, except for length, and stator blades are similarly standardized. No sophisticated material is used in construction; design philosophy was geared to ease of disassembly, "fixed geometry" of compressor and simplified fuel and propeller controls. Overhaul periods will be 1,000 hr., according to Pratt & Whitney.

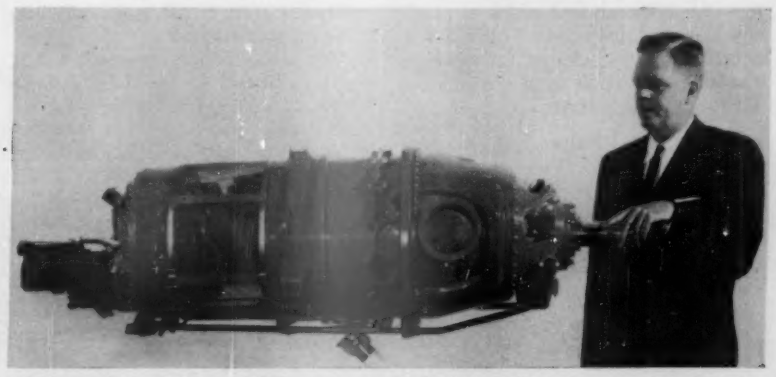
Designers reversed the conventional engine layout in the PT-6, avoiding the use of concentric shafting. Free power turbine then is directly connected to the planetary reduction gearing in the nose section, which provides 6,800 rpm. for the turboshaft version in a single stage of gearing. By addition of the second stage of gearing, the turboprop version provides 2,350 rpm.

Most installations will utilize a scoop-type cowling inlet, leading the air to a plenum chamber formed by the wasp-waisted compressor-inlet section. Air enters the engine near the rear of the nacelle and is compressed by a single compressor assembly connected to the first turbine. The second, or free, turbine is spun by the gas flow from the first turbine and is directly linked through reduction gearing in the nose section to the propeller shaft. Exhaust gases are discharged through twin ports on each side of the nacelle aft of the nose section.

PT-6 Ratings

(Sea Level Static)

PT6A-2:	Shaft Horsepower	Rpm.	Max. sfc. lb./eshp./hr.
Takeoff	500	2,350	.69
Max. Continuous	450	2,270	.71
Normal Rated	400	2,180	.74
PT6B-2:			
Takeoff	500	6,800	.71
Max. Continuous	450	6,400	.73
Normal Rated	400	6,000	.75



MOCKUP of the 500-hp., 250-lb. turboprop/turboshaft PT-6 accentuates its small size. Standing alongside is Thor E. Stephenson, president, Canadian Pratt & Whitney.

UPWIND-DOWNWIND landing maneuver by three Vickers Supermarine Scimitars of 807 Squadron, Royal Navy, was a high point in the SBAC display. Two planes landing downwind folded their wings in time to allow a third landing upwind to pass between them.

British Aviation Vies for Export Sales

By David A. Anderton

London—Britain's aircraft industry is facing a tough battle to maintain its position as a leading exporter of successful and salable products.

In spite of its outstanding sales record during the past decade, and its current estimate of exports for this year totaling close to half a billion dollars, there are strong signs that the industry is seriously concerned about its future.

External competition has never been stronger. United States and French transport producers have been selling to European markets that were traditionally British. Sweden and Italy have joined the competition for military orders. Some British spokesmen privately express strong fears that within a few short years they will be facing even tougher competition from a revitalized German aircraft industry.

Industry Rumblings

There are rumblings within the industry, too. A pamphlet issued under the sponsorship of the Association of Supervisory Staff Executives and Technicians raises again the demand for a socialized industry.

Clive Jenkins, national officer of the association and author of the pamphlet, says the government should sponsor increased research and development and should support credits to assist airline financing of the British purchases.

Sir Aubrey Burke of de Havilland, president of the Society of British Aircraft Constructors, has called for remarkably similar goals.

Sir Aubrey would like to see the government underwrite the first production run of any airplane that looked like a money-maker, and he would also like to see the credit situation straightened out so that terms comparable to U. S. offers could be made to the uncommitted airlines.

British aircraft research and development has been running at a low level since the early postwar decision not to proceed with a manned supersonic research aircraft. This government decision was a key factor in Britain losing its position in the race.

The only supersonic research aircraft flying in Britain is the Mach 2 Fairey Delta 2, serving as an aerodynamic test vehicle for engine and airplane performance data and wind tunnel calibration. Bristol's T.188 all-steel research airplane has yet to fly. When it does, it is expected to give data in the Mach number range already covered by a family of U. S. research aircraft whose usefulness ended several years ago. Its high-speed performance will not be much above that of the English Electric P.1B now approaching squadron service with the Royal Air Force, or of many of the fighters now in operational service with USAF squadrons.

But both Sir Aubrey and Clive Jenkins, viewing the situation from poles apart, have cited the credit situation as one major blight on foreign business deals.

Britain's standing as the world's largest purchaser of food and raw materials gives it an enviable position for dealing with the demands of other countries. Many of them have sterling credits as a result of their sales to Britain.

Those who don't may be able to work out a barter deal, in which aircraft are traded for cotton or coffee. Here also Britain is in an excellent position because of her needs for so many commodities.

Credit Difficulties

But the British are hampered by the terms under which they can offer financing to a small airline. Five-year credits are the current government policy, unless the British firm can prove that longer terms are being offered by the competition. It is not generally known that British aircraft manufacturers have to use every strategy to establish their own right to long-term financing aid from their government.

Said one technician: "We can give an airline seven-year credit but only if we can prove that the U. S. is offering

ALPA Fines Jet Pilots

Air Line Pilots Assn. has imposed $5,000 fines against 17 Pan American World Airways supervisory pilots who flew initial jet schedules while the union and the company were negotiating for a new contract. In addition, ALPA has suspended the pilots until Aug. 15, 1961.

Pilot sources say, however, that few if any of the pilots will choose to pay the fine, which is due not later than Nov. 15, 1959.

Several of the pilots have already resigned from ALPA.

In all, 21 supervisory pilots from all of Pan American's divisions served on the jet flights between Oct. 26, 1958, and Feb. 4, 1959. Some of them were not members of ALPA.

the same thing. So we go to the customer and tell him we can offer him only five-year financing. He says the Americans are going to give him seven years to pay. We then tell him that we can do exactly the same thing, if he will put the American offer in writing. If he does, fine, if he doesn't, then we simply have to get the letter in which the Americans have made their offer."

Armed with this written proof of American intentions, the British manufacturer can get reluctant government credit for airplane financing over a seven-year period.

But financing is only one of the major criticisms leveled at the industry through a variety of levels from commonwealth press sniping to written polemics by senior engineers or test pilots.

One of the loudest cries has been that there are too many firms and too many projects. During the past 18 months, this criticism has been dying slowly, killed by a succession of mergers that have taken place. Totaling 13 of one kind or another, these regroupings have provided additional stability, financial strength and technical numbers to the industry. There is evidence that the settling process is still under way, and that there will be further groupings.

One of these very logically should be a formal merger of Hunting-Percival Aircraft interests with those of Fairey into the de Havilland group, as a result of their current collaboration as Airco on the DH-121 short-range airliner. Most recent was the absorption of Folland into the Hawker-Siddeley Group as a result of a recent stockholders' decision.

Criticism of too many projects seems still to be valid.

An aircraft industry with a total population of about a quarter-million is supporting 11 new fixed-wing transports in either proposal, design, or mockup stages, and another 11 fixed-wing transports in production for civil and military customers. This level of activity is superimposed on a fairly large base of military aircraft in design or production, a thriving helicopter industry and increased emphasis on missiles.

Seasoned Observers

Many seasoned observers of the British aircraft industry know that many of these airplanes will never get off the drawing board, let alone the ground. But their development represents manhours of engineering time that could be used more productively.

The answer to many of these complaints seems to be that the industry must contract, regroup and concentrate on a reasonable number of airplane designs featuring economy of cost and operation.

Some people want this to take place through government ownership, through nationalization under a labor government. Others would like to see it take place quietly through amalgamation arranged by the machinery of corporations.

Where the industry policy will go after the forthcoming national elections is anybody's guess. It depends on the government and the lobbies of unions and industry in the post-election days.

Caravelle Orders

Paris—Varig Airlines will inaugurate Sud Caravelle jet transport service between Brazil and New York before the end of 1959.

Varig officials, here to take delivery of the airline's first Caravelle, indicated they planned to start the operation by the middle of December. The Brazilian carrier has ordered two of the twin jet airliners and holds an option on three more. Varig takes delivery of its second Caravelle in December.

Sud Aviation officials, anxious to crack the U. S. market, are hoping the Varig schedule, which will be the first Caravelle commercial operation in the U. S., will help stimulate U. S. sales. United Air Lines, among the several U. S. carriers reportedly interested in the Caravelle, is considered the most serious candidate.

Alitalia, the Italian airline, reportedly will order four Caravelles and will take an option on four additional aircraft.

French Transport Minister Robert Buron disclosed Alitalia's intentions, although there was no immediate confirmation from Sud Aviation or the airline.

If the order is confirmed, then Sud's Caravelle backlog will rise to 55 aircraft, of which 16 will be delivered by the end of 1959. In addition, the French company has received 24 options on its Caravelle airliner which already is in service with Air France and SAS.

GNAT TRAINER lands with drag chute streaming and rubber burning off the tires. Quantity order is expected from RAF.

USAF Considers Establishment Of Integrated Materials Center

Washington—Air Force is considering formal establishment of an integrated Materials Central to serve as the focal point of all materials research and development now under way.

Materials Laboratory at Wright Air Development Center already has started functioning as a clearing house for evaluation data on materials programs, but has not yet been formally designated the Materials Central.

The Materials Central would serve as an information clearing house and provide a single place where requirements, programs and technical evaluation data would be available to industry and the military services. Project was described by Maj. Gen. Marvin C. Demler, USAF director of research and development, at the 14th annual meeting of the Armed Forces Chemical Assn.

University Program

A new university program for strengthening the materials research effort was detailed by George P. Sutton, chief scientist of Advanced Research Projects Agency. ARPA has committed $17 million to support establishment of materials research laboratories in a number of universities which will combine the talents of various scientific and engineering disciplines.

ARPA intends the program as a training ground for new specialists, as well as a source of basic research work in the materials field.

Commenting on the increasing demand for more advanced materials as weapon systems move into new environments, Gen. Demler said the military services are finding it increasingly necessary to turn to basic research for the significant breakthroughs essential to progress.

He said that more knowledge is needed about fundamental processes and properties and that, through better understanding of these factors, some master plan may be found for producing compounds with predetermined mechanical, chemical and physical characteristics.

Gen. Demler said that such molecular engineering could totally revolutionize materials development, and he suggested that, instead of spending years characterizing substances in order to find one that will do a job, a future chemist may synthesize a material specifically tailored to the job.

Propellant Developments

Development of high-energy solid propellants was discussed by Dr. Evan C. Noonan of the Naval Ordnance Laboratory. Noonan stressed these points:

- **Most fruitful area for high** energy propellant research appears to be in the region where low molecular weight gases are formed at reasonable flame temperatures.
- **Energetic binders should** be substituted for part of the oxidizer in composite propellants in view of the requirement for high elongation at maximum stress for case bonded propellants.
- **Energy content of elastomeric** binders used in composite propellants should not be sufficient to support detonation in order to avoid detonation sensitivity.

Drawbacks of using an algae system to produce oxygen on long space trips were outlined by Alton E. Prince of the Wright Air Development Center Materials Laboratory.

Prince said it is possible to produce sufficient oxygen by using single cell algae in a photosynthesis system, but he also pointed out that, "when one tries to grow these minute plants, it doesn't take long to learn that they have all the perversities of some of the multicelled higher organisms, but they can't read and frequently won't follow directions. These small plants may be used for lack of another way on the first long-range trips into space, but there has to be a better way, a more reliable way, to produce oxygen."

WADC Aerospace laboratory has studied some other methods of producing oxygen, including photolysis of water by solar energy, a system that would be more efficient outside the atmosphere where there is more ultraviolet light. Prince said one of the more successful systems depends on photolytic oxidation and reduction of cerous and ceric perchlorates, as photolytic catalysts, in perchloric acid solution. Electrolysis of water is another method under study, and among non-biological methods of producing oxygen, Prince said this approach appears most feasible.

Bioelectronic Possibilities

Commenting on the possibilities of bioelectronics, Prince said that in view of the reported discovery of the synthesis of "giant" protein molecules, the chemical and electrical nature of nerve cell processes should be studied so that more can be learned of their ability to search out, identify and make decisions. With more knowledge of the molecular structure in the living cell, Prince said "the synthesis of polymeric chains which would be responsive to an electric signal, select the necessary information and make a decision is a necessity.

"The ultimate purpose would be to utilize the materials developed in a device which could accomplish comparable activities. And certainly such a material would find wide use in guidance systems in vehicles for the extended exploration of space."

Minuteman Silo Test

Edwards AFB, Calif.—First full-scale model of Air Force's Minuteman solid propellant ICBM was launched here last week from an underground silo test installation. Only the first stage of the missile contained propellant. The second and third stages were dummies designed to simulate weight and configuration characteristics of the missile.

Prime purpose of the launch was to test design characteristics of operational launch silos.

Two of the underground installations have been constructed here, each measuring 26 ft. in diameter and 83 ft. deep (AW Sept. 14, p. 33).

First stage contained only enough propellant to accomplish the silo launch. It probably was a boilerplate version of the unit rather than the actual stage projected for the operational Minuteman missile.

The full-scale model was tethered for the test and was restrained from free flight by a long nylon cable attached to the missile nose, which permitted it to reach an altitude of only a few hundred feet.

A series of tests will be conducted at the Edwards site to investigate silo characteristics.

Gaylord Heads Bell

Niagara Falls, N. Y.—Harvey Gaylord, former senior vice president of Bell Aircraft Corp. and head of its wholly-owned subsidiary, Bell Helicopter Corp., was named president and chief executive officer of the over-all corporation last week.

Gaylord, named senior vice president of the parent firm last year, succeeds Leston Faneuf, who took over the post in 1956 upon the death of founder Lawrence D. Bell.

Faneuf will remain as chairman of the board and chairman of the executive committee.

A Bell spokesman said that, for the time being at least, Gaylord will divide his time between the corporation's home office at Niagara Falls and Bell Helicopter's Fort Worth plant, retaining his home in Texas until after the first of the year.

Boeing Fabricates Minuteman ICBM Silo Sections

Minuteman solid propellant intercontinental ballistic missile silo sections are being fabricated by Boeing Airplane Co.'s Aero-Space Division. Sections are about 9 ft. high and more than 18 ft. in diameter. Underground silo test sites are now being completed at Edwards AFB, Calif. (AW Sept. 14, p. 33). Silo test site consists of a pair of holes, each 83 ft. deep and 26 ft. in diameter, separated by about 400 ft. between centerlines. Each hole will contain an elevator for personnel and parts which will parallel the 18-ft.-dia. Minuteman silo. These silos will be used for tests of the Minuteman first stage. Truncated cones in background are structural fairings for dummy noses which will be used in initial Minuteman silo test firings.

News Digest

Fairchild Engine & Airplane Corp. has raised the price of its F-27 turboprop transport from $635,000 to $720,000; price of the F-27A, formerly $695,000, will be $780,000 in airline configuration. New prices include higher authorized gross weight and standard airline interiors (AW Apr. 13, p. 129).

Sud Aviation has flown its first Sikorsky H-34 helicopter, built completely under license in France (AW June 29, p. 28). The French company has a government order for 150 of the heavy helicopters.

Canadian Pacific Airlines has ordered two additional Bristol Britannia turboprop airliners to be delivered to Vancouver, B. C., in October and November. The order brings Canadian Pacific's fleet of Britannias to eight, and total Britannia sales to 80.

First Bell HU-1A turbine-powered helicopters delivered to U. S. Army field units have been flown to the 101st Airborne Division's Aviation Company, Ft. Campbell, Ky. Initial duty at Ft. Campbell will be to check out the unit's helicopter pilots. The HU-1A, which has attained speed of 160 mph. in level flight, probably will see active duty with the 101st during its maneuvers next year.

Norden Division of United Aircraft Corp. will build a multi-million dollar engineering research and manufacturing facility on an 80-acre tract at Norwalk, Conn. Unit will consolidate Norden operations now carried on at Stamford and Milford, Conn., and White Plains, N. Y., according to Robert A. Astinwall, general manager.

Hawker Siddeley Group, Ltd., has won control of Folland Aircraft, Ltd., in a bid to buy all outstanding shares in the company. Its offer (AW Aug. 3, p. 30) was accepted by holders of 1.4 million shares, over 90% of the total.

Radiation, Inc., Florida Division, will develop and install communications and tracking antennas for Project Courier, Advanced Research Project Agency's program to establish a world-wide communications system using satellite relay stations, under a $1,283,000 contract.

X-15 Flies on Power

Edwards AFB, Calif.—North American Aviation's X-15 high-altitude research plane flew last week under rocket power for the first time. It was launched at 38,000 ft. from a mother B-52 traveling at 255 kt. IAS with NAA's Scott Crossfield at the controls.

Two barrels of the rocket powerplant ignited almost immediately. The remaining six barrels ignited in 3-5 sec. after launch. Total thrust was approximately 16,000 lb.

Gross weight of the X-15 at launch was 33,000 lb. and maximum velocity achieved was in excess of Mach 2. Crossfield carried out a shallow climb to 50,000 ft. and then turned back to Muroc dry lake bed for landing. Powered flight lasted 3.5 min. and total duration of flight was approximately 10 min. Maximum acceleration was 5g, and better acceleration values than expected were achieved.

Speed at landing was about 180 kt. IAS. Approach and landing were very smooth and roll out was about 8,000 ft. Final approach and flare were in contrast to oscillations which were experienced during the first unpowered flight. Aircraft used was the second delivered so far.

Hector Quits, Says CAB Unsuited to Task

Letter of resignation criticizes board practices; departure could delay passenger fare case ruling.

By L. L. Doty

Washington—Louis J. Hector resigned from the Civil Aeronautics Board last week with a blunt charge that an independent agency is "not competent" to regulate a vital national industry in the public interest.

In a letter of resignation to President Eisenhower that bristled with sharp criticism of Board practices in controlling the airline industry, Hector lashed out at the present regulatory system which, he said, "hobbled" civil aviation and does not work. With the letter, Hector submitted a 72-page critical survey of independent agencies which called for the transfer of policy-making and administrative functions to an executive department, with major litigation cases being handled through judicial processes. He also proposed the formulation of general standards and policy that would apply to all major cases in a move to create an administrative body that combines policy-making with adjudication.

In "regretfully" accepting the resignation, Eisenhower said he was sending Hector's ideas "to the Secretary of Commerce under whose direction a general study encompassing the whole subject is under way."

Hector's resignation, effective immediately, drops Board membership from a full total of five to four and may delay a White House decision to give Chairman James Durfee a recess appointment as Judge of the Federal Court of Claims. The Court of Claims convenes in October.

If Durfee should win a recess appointment, however, and leave the Board this fall, the Board membership would be reduced to only two veteran members—Vice Chairman Chan Gurney and G. Joseph Minetti—since Harmar Denny's term expires the end of this year. Denny reportedly has no desire to serve a second six-year term.

Industry observers close to CAB are concerned over the prospects of a Board consisting of two experienced and three new members, once Durfee, Denny and Hector are replaced, in view of the major cases now pending before the Board, particularly the General Passenger Fare Investigation. The Board can function with as few as three members who constitute a quorum.

This situation places Franklin Stone, the Board's general counsel and a contender for a Board seat, in a favorable position as a White House choice because of his long experience with the CAB.

Other contenders to fill the expected openings include former Republican Sen. Charles Potter of Michigan, former Republican Congressman Pat Hillings of California, Edward Sweeney, a Washington attorney, and George M. Moore of the Post Office Department.

Hector's resignation did not endear him to fellow members of the Board since his action was taken suddenly without any warning or any consultation with his colleagues. In all his Board activities in the past, Hector has always worked completely independently. In addition, Hector's criticism of the Board's procedural processes has served to bring to light a low morale factor that exists in some areas at staff level. Staff members, for example, have expressed privately a sense of deep frustration in formulating plans and programs that are rejected by the Board because of a lack of policy in the first place and, they say, a lack of Board guidance in the second place.

Hector first publicly disclosed his dissatisfaction with this issue in a recent speech before the American Bar Assn. in Miami. Citing the problems an examiner has in writing an initial decision, Hector chose the Seven States Case as an example of the Board's cumbersome process in reaching decisions and said:

"Now it is clear that the examiner . . . had only the remotest idea of what the Board wanted him to do. True he had some miscellaneous Board precedents to go on, but no real policies to guide him in the formulation of a major new local service plan. So he floundered around for two years formulating his own plan only to have the Board disagree with him on basic policy and do the whole job all over."

In this speech, Hector also made his strongest open attack on Board practices. Again referring to the Seven States Case which took three years to complete, he charged:

"If a private business tried to conduct its affairs this way it would go broke. If we tried to make our foreign policy or plan our national defense this way, we would still be a third rate power. And, if we keep on trying to plan our national transportation system this way, we will wake up in a national emergency one day and find that it won't do the job. Clearly these procedures must be overhauled."

In his memorandum to the President, Hector criticized the Board's reversals of the examiner's decisions in the New York-Florida and Great Lakes-Southeast Service Cases. At no time, however, did he single out an individual for criticism.

Hector, who up to the time of his resignation had served only two and one-half years of his six-year term, has long crusaded for more competition and less regulation. In the past six months, no less than five of his dissents have expounded this philosophy. Recently, he bluntly criticized Board proceedings in a dissenting opinion when he stated that allocation of time to witnesses in service cases was "an unfair mode of procedure" because of the disproportionate representation of the cities involved.

Hector, along with his colleague

Vertol 44 Fleet Grounded Briefly

New York—Helicopter fleet of New York Airways was grounded overnight Sept. 11 while a modification was made to engine cooling fan assemblies. The airline had planned to install the fix on its Vertol 44B helicopters over a week-end-staggered schedule, but a fan failure just prior to a takeoff from La Guardia Airport resulted in the decision to ground the fleet and do all the work at once.

Involved was a structural weakness in the engine cooling fan blade and disk assembly, according to New York Airways. It was corrected by installation of a higher strength forged blade and reinforcement of the disk assembly.

The failure occurred during the afternoon. Working all night, the airline had two of its five Vertols back in service next morning, a third by noon, and the other two by late afternoon.

G. Joseph Minetti, a proponent of lower fares and never has shown any indication that he would support a fare increase in the General Passenger Fare Investigation.

However, his dissensions indicate that he would be willing to allow fares to reach a natural level through competition. He emphasized this point in his letter of resignation when he said:

"It is my belief also that we are trying to regulate far too many details of civil aviation—details which could better be left to management discretion and the free play of competition." He added: "Provided the government retains always the basic residual powers necessary to prevent unfair competitive practices or excessive profits under a federal license, many of our detailed controls of rates and practices of the airlines could be terminated."

He gave every evidence of possessing a full appreciation of a free enterprise system as a key to air transportation success. For example, in dissenting against a majority opinion to require carriers to publicly disclose equipment purchase plans, he said, "since equipment purchasing may be an important competitive weapon . . . I think a carrier should be allowed to keep its detailed plans confidential if it so desires."

His failure to win over a majority of the Board members to his views on less regulation was undoubtedly one of his reasons for resigning. A study of his activities during the past two and one-half years indicates that he may finally have been forced to rebel openly against a system which he felt barred him from doing the job that he believed needed to be done. He fought for "a good, old-fashioned profit incentive."

In his Miami speech, he reported that he is not opposed to full process and judicial procedures in route cases but that a "great many irrelevant aspects" of these procedures could be eliminated. In discussing the Seven States Case, he said "there was not too little judicial process here, there was too much."

An analysis of Hector's views on the Board's current structure shows that he apparently holds some strong opinions as to just what steps can be taken to correct the existing problems. Essentially, there is strong evidence that he would apply judicial processes to competition, licensing, selection of applicants and rate regulation in critical cases and then combine these processes with streamlined procedural steps along the lines of systems employed by executive agencies or business corporations.

Broadly, he would establish general standards and policy to apply to all major cases in an attempt to create an administrative body that blends policy-making with adjudication.

Hawaiian Statehood May Resolve Northwest-Pan American Dispute

Washington—Statehood status of Hawaii may help resolve the 10-year battle between Pan American World Airways and Northwest Airlines for control of the Pacific Northwest-Hawaii route. A Civil Aeronautics Board hearing examiner last week recommended that the route, now a inter-state flight, be served permanently by a single airline—Northwest.

Examiner Ferdinand D. Moran based his recommendation on the ground that the route will support only one carrier and proposed Northwest as his choice from both an economic and incentive standpoint. Moran's report also emphasized the fact that the route is now inter-state transportation, eliminating the necessity for White House approval of the CAB decision, which twice in the past 10 years has placed Pan American back on the route after the Board had named Northwest as the sole operator.

Tracing the background of the route battle, Moran pointed out that the Board first selected Northwest in 1948 in the Pacific Northwest-Hawaii Service Case and denied Pan American's application. The White House, he said, approved the CAB decision but subsequently directed that Pan American also should be given similar authority since insufficient weight had been given to the needs of the Pacific Northwest for direct service beyond Hawaii. In the West Coast-Hawaii Case, the Board selected Northwest for permanent certification over the route and found that Pan American's authority should be terminated. The White House, Moran noted, again directed that both airlines be certificated for an additional three-year period.

Statehood granted Hawaii on Aug. 21 places the route consideration in an inter-state classification not subject to Section 801 of Federal Aviation Act which makes air carrier certification for overseas or foreign air transportation subject to presidential approval.

"Critical" question remaining, Moran said, is whether the route should have two carriers, since traffic for the two carriers last year amounted to only about 26 passengers per day in each direction for each airline during the peak travel season. He estimated that this figure will increase to an average of only 29 passengers per day for this year.

Operational figures submitted by the competitors show that they suffered a combined operating loss of more than $3.3 million during the past two years, Moran said.

Daily frequency of jet flights by Pan American and Northwest by early 1961 would result in an over capacity of available seats, lowering the load factor for each carrier to only 40% as compared with Northwest's 57.8% for the route in 1957 and Pan America's 53.4%, Moran said.

Noting that both airlines had lost heavily on the route and could be expected to do so in the near future, Moran said the situation is inconsistent with CAB's statutory obligation to promote sound conditions in the industry.

"As experience has proved," he said, "there is no justification for authorizing more than one carrier to operate over the route. The Board twice found need for only one carrier and the record of what has been achieved by two carriers in the market reaffirms that finding."

Moran added that Northwest would have a greater incentive to service the route since, in times of equipment shortage, Pan American would favor its California flights because 86.5% of the U. S.-Honolulu traffic uses California gateways.

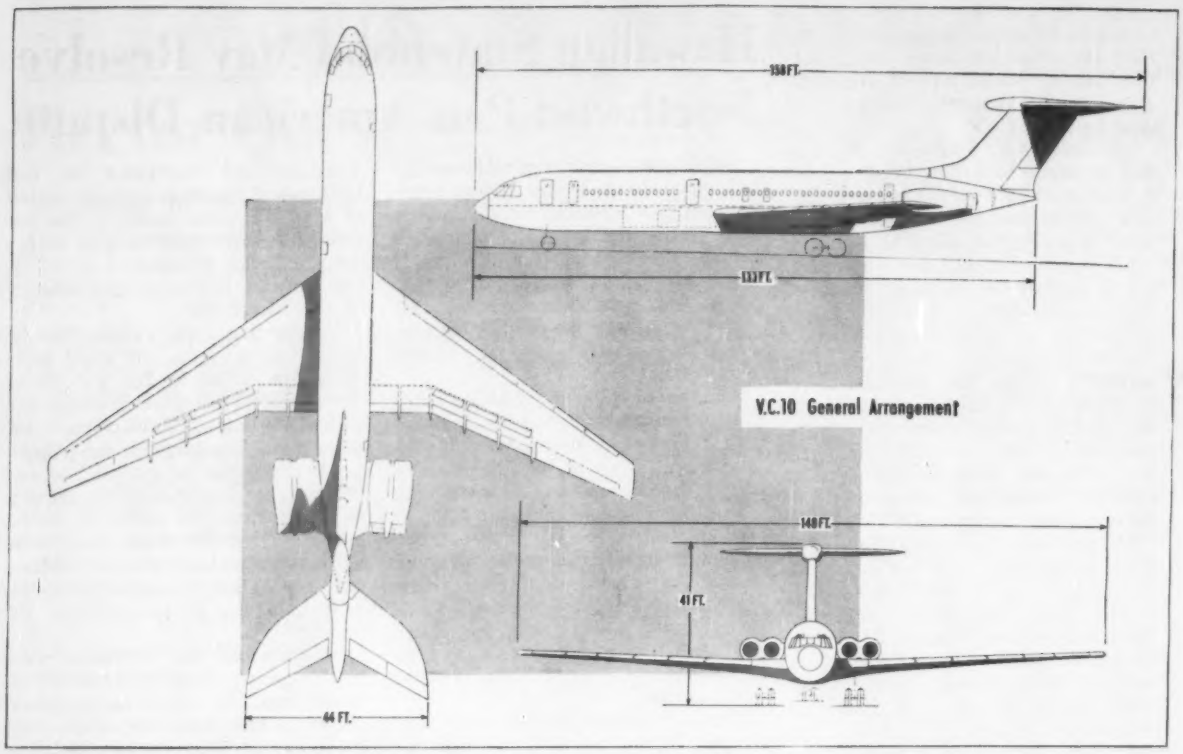
Rickenbacker Urges Transport Emphasis

London—E. V. Rickenbacker, Eastern Air Lines board chairman, urged last week that greater emphasis be placed on development of air transportation as a key to world peace.

Delivering the sixteenth Brancker Memorial Lecture at the Institute of Transport, Rickenbacker said "we have long since reached the point of crisis in our world affairs where the true potential of the airplane as a power for peace must be fully exploited to meet the urgent needs of mankind."

Terming the past development of air transportation "nothing short of spectacular," Rickenbacker added that the growth thus far has been attained on the "relatively few crumbs our civil aviation has been able to garner from the heaping platter of our military development . . . through our failure to recognize the transport airplane's power for peace, it always has been, and still is today, the stepchild of the aviation industry."

The Eastern executive said that diversion of a small fraction of the funds being spent on military developments could, "more than all the political conferences," help erase the "economic inequalities and political uncertainties that stand in the way of man's peaceful progress."



VICKERS VC.10 four-jet transports over-all length is 158 ft. 10 in. Over-all height is 39 ft. 1½ in.; wing span is 140 ft. British Overseas Airways Corp. has ordered 35 VC.10s, with an option for 20 more. BOAC's deliveries are scheduled to begin in 1963.

Vickers Enters Initial VC.10 Production

Weybridge, England—Britain's biggest aircraft project, the four-jet Vickers VC.10 transport, is beginning to take shape in jig and component construction here.

The VC.10 has been ordered by British Overseas Airways Corp. for deliveries starting in 1963. Initial order was for 35 complete aircraft powered by Rolls-Royce Conway bypass engines, with a total value of about $168 million. BOAC also has an option for 20 additional planes.

First of the VC.10s is expected to fly in less than two years and should be at Farnborough in 1961.

TWELVE-FOOT WIDTH of Vickers VC.10 cabin can accommodate six-abreast, five-abreast or four-abreast seating arrangements. Section shown is part of full-scale wooden mockup.

Fuselage and wing structural jigs are being built now on the main factory floor here, and a complete wing torque box specimen section is nearing completion. A fuel system test rig is also under construction.

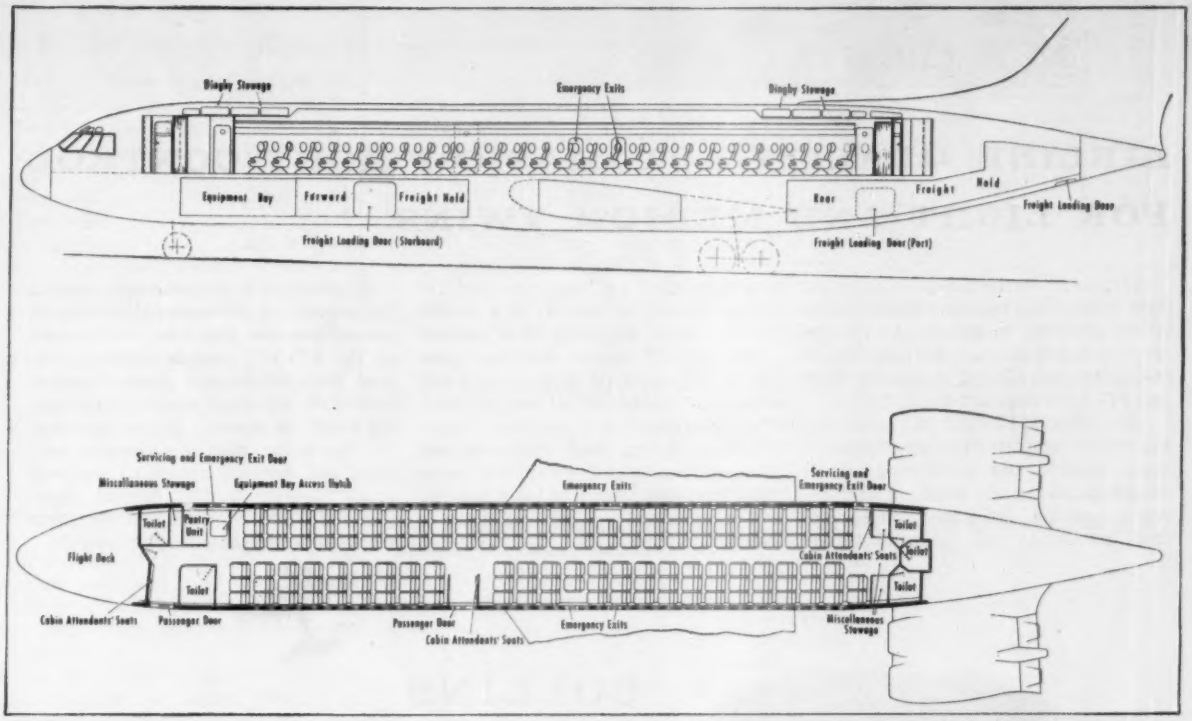
In addition to these full-scale components, much model work has been done in five Vickers wind tunnels and eight others located in Britain. More than 2,000 hr. test time has been accumulated on five large models used for low-speed tests, 11 used for detailed low-speed work, and 18 used for high-speed development.

Ditchings Simulated

Simulated ditchings have been made with models, and powerplant investigations—including engine intakes, nozzle and silencer studies—have also been completed for the design.

First engineering and performance details of the big transport were released at the 20th Society of British Aircraft Constructors Flying Display and Exhibition. Calculated performance emphasized the design aim of Vickers' engineering teams to produce an airplane with large payload and outstanding airfield performance.

The company says there were two



STANDARD LAYOUT of VC.10 gives six-abreast seating on a 34-in. pitch to 150 passengers. Five toilets, two galleys and double passenger entrances are included. The crew has a separate toilet and a rest area. Non-structural bulkheads form cabin dividers.

Phases

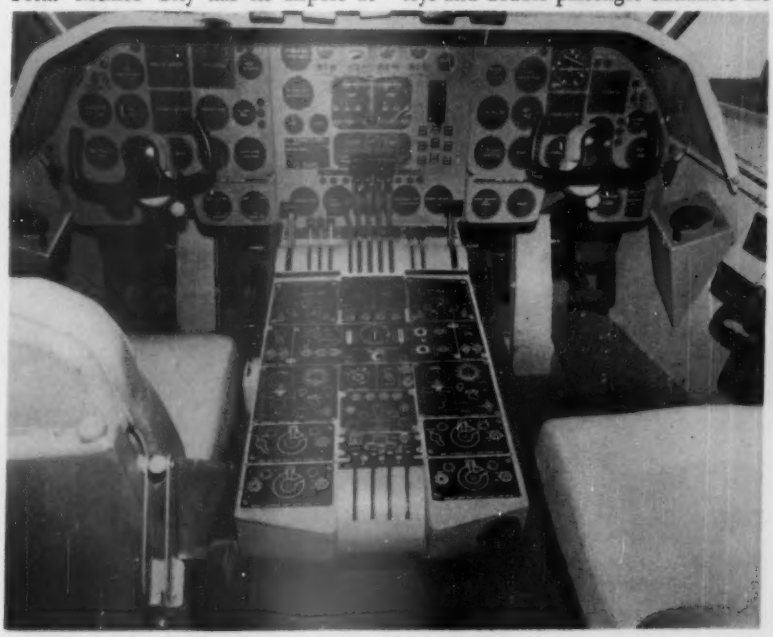
types of designs possible at the time they began work. The first would have been a faster second-generation transport; the second would have featured airfield performance and economy. They chose the second, concentrating on obtaining airfield performance for a 600-mph. cruise speed.

These kinds of design parameters mean a clean wing, with high-lift devices and all the latest tricks of the aerodynamic trade. A clean wing meant engines at the rear, as in the Sud Aviation Caravelle, and Vickers chose four Rolls-Royce Conway engines, pylon-mounted in pairs. Current production Conways are rated at 17,500 lb. thrust each, but by the time they are needed for the VC.10 they may be developing about 1,000 lb. more thrust, with a further increase possible to about 20,000 lb.

Major performance requirement was a minimum restriction on takeoff weight at hot or high airfields. The VC.10 is being designed to a takeoff maximum weight of 299,000 lb. and has a 38,000 lb. design payload. Calculations show that the maximum restriction imposed on the plane would be at Kuala Lumpur, Malaya, which has a 6,000-ft. runway at a field altitude of 1,000 ft. and a temperature on the order of 90F. For this condition, the gross weight at takeoff would be cut by 53,000 lb., which would have to come out of the fuel or the payload.

Vickers calculated performance also shows that the VC.10 should be able to take its full payload of 38,000 lb. nonstop from Mexico City to New York. Mexico City has its airport at a 7,000-ft. elevation with a prevailing average temperature (used for calculations) of 75F. Calculations include one hour and 250 mi. reserve fuel.

Standard layout of the VC.10 cabin gives six-abreast seating on a 34-in. pitch to 150 passengers. Five toilets, two galleys and double passenger entrances are



MOCKUP shows layout of forward portion of the VC.10 flight deck. The cockpit has five seats—for pilot, copilot, flight engineer and navigator, plus a check pilot or observer.

NEW FROM COLLINS

AIRLINE QUALITY AUTOMATIC FLIGHT CONTROL FOR LIGHT AND MEDIUM TWINS

Advanced performance automatic flight control and instrumentation, never before available in lightweight systems for twin engine aircraft, are now offered in Collins new AP-102 Automatic Pilot and FD-107 Integrated Flight System.

The AP-102/FD-107 are combined to provide complete, transient free automatic control and monitoring of all modes of automatic flight. Flight director steering, integrated "flight picture" navigation and primary attitude instrumentation are also provided for manual control of aircraft in a combination system weighing 89.6 pounds.

The AP-102 enables automatic control of all standard flight maneuvers; acquisition and holding of selected headings; glideslope and localizer course following during final approach with automatic crosswind correction; automatic trim and control of pitch attitude, and automatic level off and hold of selected altitudes.

Replacing at least four single purpose instruments on conventional instrument panels, the two integrated instruments of the FD-107 provide primary attitude and navigational situation information during either automatic or manual flight. A steering pointer monitors the automatic pilot during automatic flight and presents computed flight director steering during manual flight. The FD-107 utilized without the Automatic Pilot, weighs only 22.5 pounds.

COLLINS AP-102 FD-107

LIGHTWEIGHT AUTOMATIC PILOT AND FLIGHT DIRECTOR

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

VC.10 Specifications

Maximum takeoff weight	299,000 lb.
Design payload	38,000 lb.
Over-all length	158 ft. 10 in.
Over-all height	39 ft. 1½ in.
Span	140 ft.
Wing area	2,800 sq. ft.
Aspect ratio	7
Fuselage length	133 ft. 8 in.
Fuselage maximum width	12 ft. 4 in.
Fuselage maximum depth	14 ft. 1½ in.
Passenger entrance door sill height	10 ft. 6 in. (approx.)
Underfloor freight capacity	
Forward hold	535 cu. ft.
Rear hold	815 cu. ft.
Freight hold working depth	4 ft. 7 in.
Freight hold maximum floor width	4 ft. 6 in.

included in the layout; the crew has separate toilet and a rest area.

Three other alternate arrangements have been proposed to airlines by the company:

- **First cabin class,** which takes 105 passengers seated six abreast with 40-in. seat pitch.
- **Standard first class,** either for 88 passengers five-abreast with 40-in. seat pitch, or 70 passengers in four-abreast seating with the same pitch.
- **Luxury class,** with 52 passengers in fully reclining seats, four abreast on a 54-in. pitch, and room for nine overhead berths.

Mixed class configurations can be arranged by using non-structural bulkheads to divide the cabin into separate areas.

VC.10's flight deck has room for a crew of five: pilot, copilot, flight engineer and navigator plus seating for a fifth, who could be a check pilot. The fifth seat is so located that it can be moved on its rails to a position behind the pilots' console, so the fifth man can supervise or observe operations of both crew members.

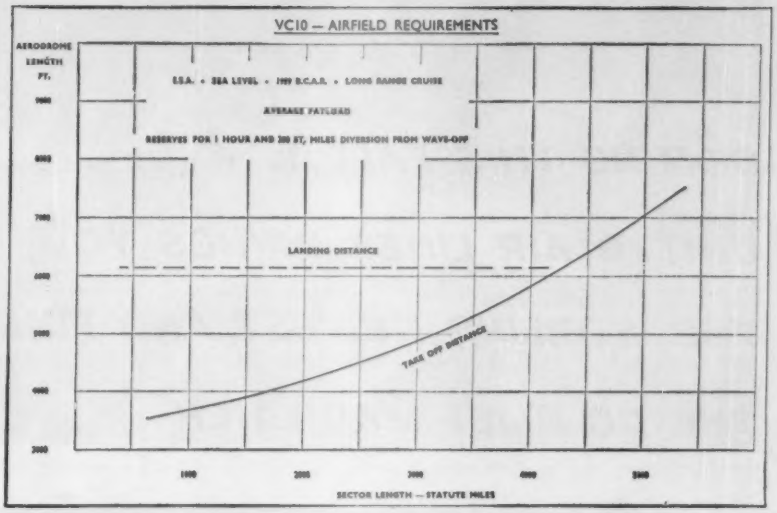
Freight Capacity

Freight holds below the cabin floor give a total capacity of 1,350 cu. ft. The hold forward of the wing has a 535-cu. ft. capacity, and the after hold takes 815 cu. ft.

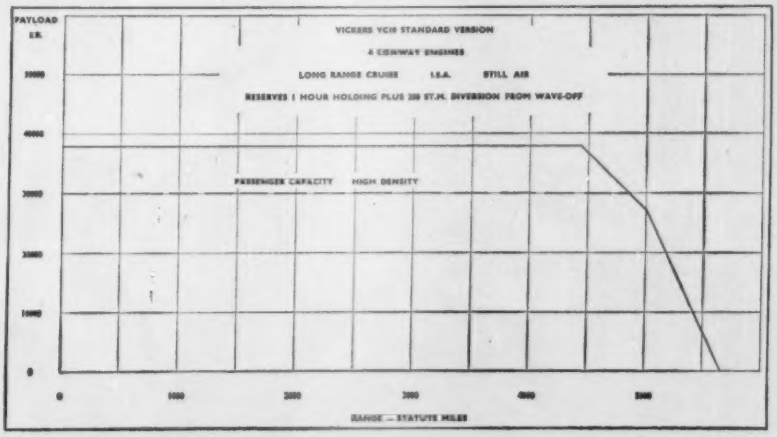
Wing structure is three-spar, using integrally milled skin panels. Fuel is carried in the main structural box in four bays, and there is a fuel transfer tank in the wing center section.

Lateral control is handled by six spoilers and conventional ailerons divided in halves to give four separate aileron surfaces.

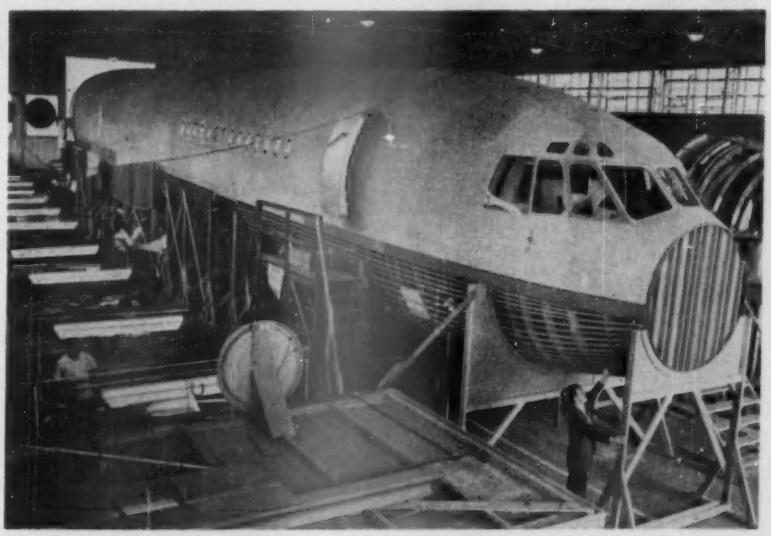
Aileron and spoiler powers are approximately equal during actual cruise conditions.



UNDER standard conditions, the Vickers VC.10 transport can take off at maximum gross weight for a 5,000 stat. mi. stage length from a runway 7,000 ft. long.



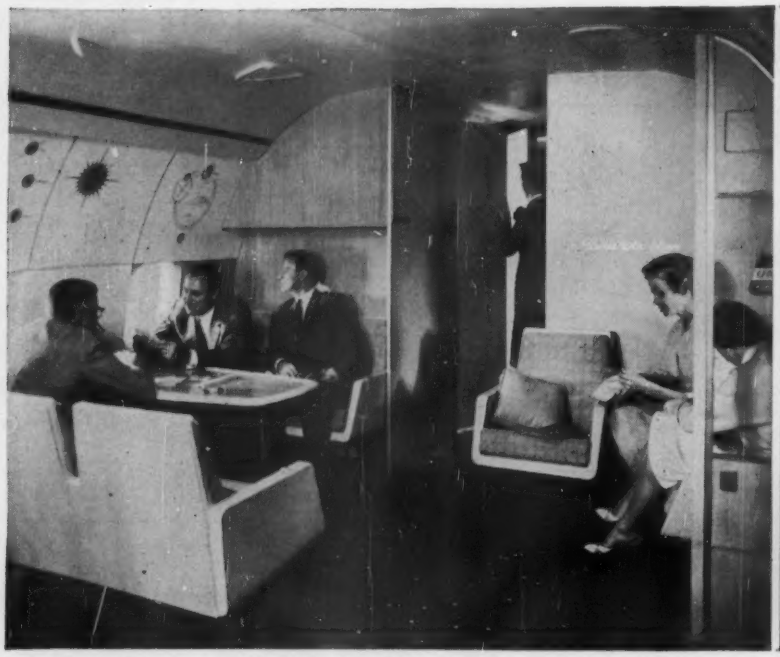
NORMAL RANGE at high density loading is nearly 5,000 stat. mi. before using reserves.



FULL-SCALE wooden mockup of Vickers VC.10 shows head room and space of the underfloor compartment. Volume of this forward hold is 535 cu. ft.

COMING THIS FALL...

UNITED AIR LINES BRINGS YOU THE WORLD'S NEWEST AND FINEST JET, THE DC-8 JET MAINLINER



THE FAMOUS RED CARPET* ROOM on United Air Lines new DC-8 runs the full width of the cabin—offers the relaxed comfort of a living room aloft. You'll find it a favorite gathering spot for jet age travelers.

COMFORT-CONTROL SEATS—lean back and your light leans with you. Cooling, ventilation, call button at your finger tips.

Newest, biggest, roomiest, quietest of all the jets. This is United Air Lines new DC-8 Jet Mainliner. Bigger than any other jet now flying or being built . . . roomier than any other jet with special comfort control seats . . . quieter than any other jet thanks to special soundproofing inside and out. United Air Lines took extra care to make this the best jet service for you—First Class or Custom Coach. Make your reservations now coast-to-coast. Call your travel agent or United Air Lines.

UNITED AIR LINES DC-8

JET MAINLINER, BY DOUGLAS

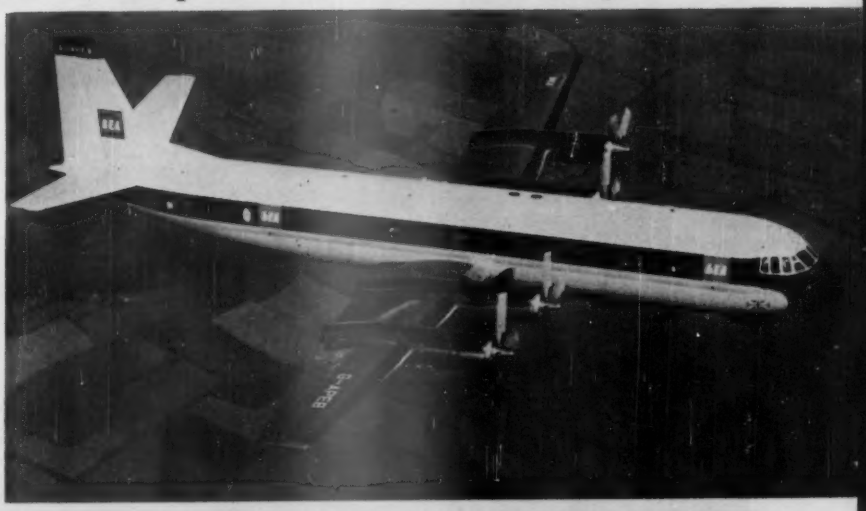
*Red Carpet is a service mark owned and used by United Air Lines, Inc.

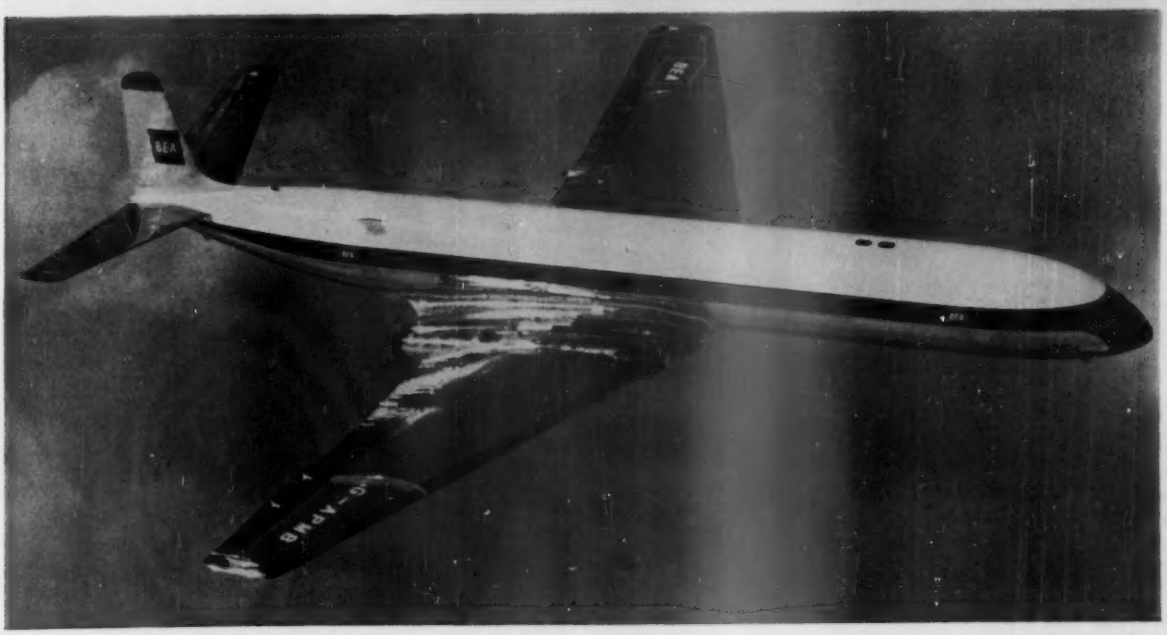
EXTRA CARE HAS MADE IT THE BEST OF THE JETS

Handley Page Herald in British European Airways markings is flown at Farnborough. BEA is using three Heralds for route-proving.

British Demonstrate Transports at Farnborough

Vickers Vanguard (right), in new British European Airways markings, is flown at the 20th Society of British Aircraft Constructors Flying Display and Exhibition at Farnborough, England. Observers were impressed with the Vanguard's large size and its flight characteristics (for pilot report, see AW Sept. 14, p. 54). The transport has been ordered for British European Airways and Trans-Canada Air Lines. Vickers is seeking additional sales so it will reach the break-even point on production commitments. The de Havilland Comet 4B turbojet transport (below) is designed to carry up to 102 passengers over 400-2,500 mi. stages, compared with 60 to 81 passengers on stages to 3,000 mi. for the Comet 4 (AW July 13, p. 52). The 4B was designed specifically for a BEA requirement.

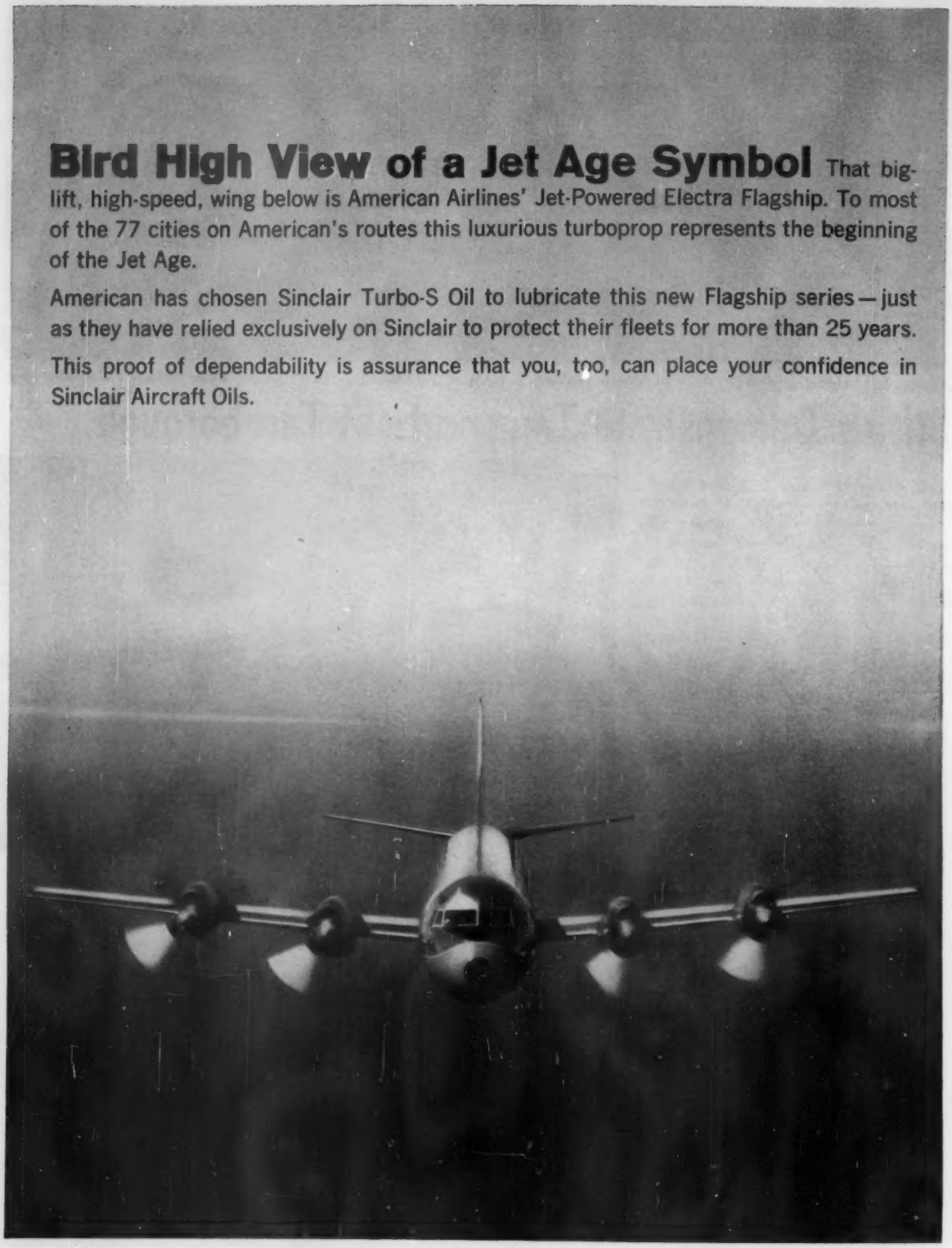




Bird High View of a Jet Age Symbol That big-lift, high-speed, wing below is American Airlines' Jet-Powered Electra Flagship. To most of the 77 cities on American's routes this luxurious turboprop represents the beginning of the Jet Age.

American has chosen Sinclair Turbo-S Oil to lubricate this new Flagship series—just as they have relied exclusively on Sinclair to protect their fleets for more than 25 years.

This proof of dependability is assurance that you, too, can place your confidence in Sinclair Aircraft Oils.



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Port Authority Breaks With NATCC

By Glenn Garrison

New York—Long-standing differences over jet aircraft noise have finally caused an open break between the Port of New York Authority and the National Air Transport Coordinating Committee, local anti-noise group whose executive committee chairman is American Airlines President C. R. Smith.

American was characterized by the Port Authority earlier this month as "the one jet operator with a completely unacceptable conformance record" as far as the Port Authority's jet operating rules at New York International Airport are concerned. The NATCC has its own set of anti-noise procedures for both piston and jet aircraft, and its membership includes all U. S. jet operators using the airport.

Describing NATCC's and the Port Authority's views on the aircraft noise problem as "not compatible," Executive Director Austin Tobin has announced the complete withdrawal of the Port Authority from NATCC membership. The move followed a recent public hearing at Idlewild by a House committee concerned with aeronautics and health and safety, during which NATCC Executive Director Charles E. Rosendahl charged the Port Authority with action "so misleading as to be damaging to the entire industry effort toward reduction of the (noise) problem."

Rosendahl also said "there would be less confusion and there might be more result if the airport operator would not endeavor to form and enforce rules in an area which has logically been reserved to federal jurisdiction."

Tobin noted these charges in his letter of withdrawal, which was addressed to Smith as NATCC executive committee chairman. The Port Authority official said his agency "naturally cannot support, financially or otherwise, an industry-controlled organization which denies the right of the owner and operator of an airport to require that its facilities shall be used only in such a way that it is compatible with the reasonable enjoyment of their property by the airport neighbors."

During a recent hearing at Idlewild, both NATCC and the Port Authority put statements into the record outlining their positions on the jet noise question.

Director of Aviation John R. Wiley of the Port Authority said his agency had pioneered in the recognition of the aircraft noise problem. By its early firm stand, he said, the Port Authority contributed heavily to the development of noise suppressors. It also sponsored "scientific studies of noise . . . which permitted the development of standards in this highly technical and complex field."

Wiley said the Port Authority has the power to enforce its regulations regarding the use of jet aircraft at the airport, and could withdraw permission from a non-conforming airline. However, Wiley said, such action would be "an extreme sanction."

Executive Director Rosendahl of NATCC said that over the years since 1952 when his organization was formed, there has been a generally diminishing trend in objection to aircraft noise at the New York airports. During the summer of 1959, however, the problem has become more acute and "a rather widespread belief exists that this is occasioned by the introduction of operations by turbojet aircraft," Rosendahl said. The airport operator has set up certain recommendations for turbojet takeoffs, and "it would appear that by its public applause of some airlines for adhering completely to these recommendations, and by its public condemnation of others, the airport operator has contributed greatly to the belief . . . that lack of conformance with its turbojet takeoff recommendations is the core of the present aircraft noise situation at Idlewild.

"Responsibility for rules and regulations which govern the flight operation of aircraft lies with the federal government, and not with any other agency," Rosendahl contended.

An NATCC appraisal of published violations of Port Authority procedures, Rosendahl said, covered one airline for June, July and most of August and a second carrier for 27 days in August. Total was 343 violations. Only 71, or 21%, of the takeoff violations resulted in complaints, Rosendahl said. Furthermore, Rosendahl questioned whether the noise problem could be gaged accurately by the volume or nature of complaints.

A few days before the hearing, the Port Authority sent to the jet operators and to local community leaders another in its series of reports on conformance to Port Authority procedures, this one for the month of August. The letter noted "an encouraging improvement" for the month, with conformance at 74.7% of all jet takeoffs compared with 70% in July and 59% in June.

Trans World Airlines, the letter reported, had shown an "especially pleasing" improvement following a series of discussions "to clear up some of the misunderstandings."

But American, the letter continued, ". . . remains as the one jet operator with a completely unacceptable conformance record and no clear signs that it is making any real effort to protect the airport's neighbors from excessive jet noise. . . . We have had no assurance whatsoever from American that it is disposed to take any positive steps to improve its record. . . . On the August record of American Airlines, which it is my unpleasant duty to submit to you here, their operations are being conducted in wilful disregard of the public welfare as respects conformance with the Port Authority's jet noise reduction procedures."

American President Smith, in his capacity as NATCC executive committee chairman, replied to Tobin's letter withdrawing the Port Authority from NATCC. The Port Authority, airlines and NATCC all have the same objective in finding a way to minimize aircraft noise in the area, Smith wrote.

But while there is no difference in objective, Smith added, ". . . there has been and there is a substantial difference in opinion about the philosophy and the detail of the program proposed and insisted upon by the Port Authority. It is evidently the position of the Port Authority that it can accept no program except its own and that if others do not agree with the detail of that program [then] the firms and agencies which should cooperate in a mutual program can find no way to work together."

FAA Noise Position

Federal Aviation Agency has the basic legal authority to issue air traffic control regulations to suppress jet aircraft noise, according to Administrator E. R. Quesada.

In a letter last month to U.S. Rep. Albert H. Bosch (R.-N. Y.), the FAA chief noted the court decision in the case of the Village of Cedarhurst, Queens, N. Y., which held that the federal government had pre-empted the field of air traffic control. This does not mean, Quesada said, that FAA would act without regard to the interests of the local jurisdictions. And many legal problems are involved in the complex question of aircraft noise and its effects on the public.

Among the legal problems noted by Quesada in connection with aircraft noise control by FAA is the effect on contractual rights between airlines and local airports. It is this contractual aspect that the Port of New York Authority cites as its legal basis, as landlord of the airports, for enforcing its own anti-noise jet procedures.

Airline Income & Expenses—July, 1959

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	31,405,959	621,714	290,077	1,851,267	.....	34,602,015	29,991,411	4,610,604
Braniff	4,768,365	133,762	50,177	190,139	422	5,225,078	5,152,695	13,396
Capital	8,107,891	182,712	107,017	137,880	16,126	8,712,933	8,990,433	−277,500[3]
Continental	4,256,000	59,000	26,000	68,000	18,000	4,522,000	3,866,000	397,000
Delta	7,359,000	161,000	94,000	331,000	.....	8,109,000	7,971,000	124,000
Eastern	21,405,035	376,732	819,076[2]	.....	30,521	22,766,010	23,098,125	−663,250
National	4,153,299	78,872	22,255	147,365	65,593	4,598,835	5,231,793	−715,903
Northeast	2,707,876	33,327	24,365	41,009	.....	2,855,414	3,211,912	−356,498[2]
Northwest	6,933,923	187,984	525,657[2]	.....	4,680	7,681,665	6,903,732	698,971
Trans World	22,758,765	423,911	1,057,580[2]	.....	66,240	24,434,951	21,681,011	3,455,715
United	25,397,607	815,554	2,072,546[2]	.....	157,941	29,133,862	25,296,337	4,209,165
Western	4,849,313	93,288	34,851	112,672	32,841	5,169,634	4,001,347	1,106,560
INTERNATIONAL								
American	518,746	10,159	190	55,447	.....	611,139	546,239	64,900
Braniff	629,138	14,734	.....	40,915	.....	732,643	683,263	41,768
Caribbean Atlantic	267,618	2,322	9,648[2]	.....	645	283,863	206,290	77,891
Delta	425,000	4,000	.....	9,000	.....	455,000	458,000	−6,000
Eastern	2,604,784	40,948	94,910[2]	.....	31,205	2,773,832	2,182,840	550,531
Mackey[5]	153,973	.....	200	2,224	752[4]	165,872	141,842	24,029
National	333,194	3,523	2,145	11,297	17,286	375,869	329,275	46,594
Northwest	2,667,855	545,914	491,258[2]	.....	80,127	3,871,074	3,102,534	733,989
Pan American Combined	28,141,000	1,538,000	.....	3,175,000	1,088,000	35,202,000	31,114,000	3,961,000
Alaska	440,000	16,000	.....	38,000	1,000	471,000	498,000	−25,000
Atlantic	14,195,000	725,000	.....	1,126,000	325,000	16,868,000	13,839,000	3,009,000
Latin American	7,585,000	194,000	.....	1,146,000	117,000	9,365,000	9,327,000	37,000
Pacific	5,921,000	603,000	.....	865,000	645,000	8,498,000	7,449,000	1,084,000
Panagra	1,226,000	42,000	.....	208,000	5,000	1,623,000	1,549,000	432,000
Resort	.....	.....	.....	.....	212,102	298,438	277,823	20,615[3]
Trans Caribbean	453,769	.....	50,272[2]	.....	25,032	585,517	452,465	112,221
Trans World	6,396,581	431,018	380,588[2]	.....	1,349,138	8,775,185	8,312,086	431,118
United	1,932,790	54,137	29,273[2]	.....	.....	2,025,833	1,405,990	611,520
Western	172,960	8,634	.....	5,052	.....	371,750	335,148	30,684
LOCAL SERVICE								
Allegheny	738,419	7,355	12,406	19,022	2,302[4]	994,483	1,065,190	70,707[3]
Bonanza	323,885	2,677	1,883	6,041	16,485	503,852	572,552	−82,378
Central[1]	.....	.....	.....	.....	.....	.....	.....	.....
Frontier	547,490	13,711	4,777	30,410	8,612	1,971,285	1,126,200	821,682
Lake Central	220,427	4,800	8,979[2]	.....	1,150	385,916	368,628	17,289[3]
Mohawk	685,207	6,506	7,128	14,915	6,455	894,263	886,551	7,712[2]
North Central	1,157,640	26,887	21,500	14,459	27,462[4]	1,637,894	1,661,532	41,846
Ozark	609,182	298,392[5]	10,059	19,192	579	945,901	880,886	61,452
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont[6]	675,998	10,925	9,743	8,754	7,684[4]	1,068,285	1,039,047	−1,196
Southern	299,459	7,007	4,458	8,540	2,638	528,275	539,290	−11,015[3]
Trans-Texas	398,550	10,737	3,294	16,516	10,385	696,240	691,316	3,365
West Coast	354,466	3,629	2,106	6,135	1,984	515,477	684,731	−169,255[2]
HAWAIIAN								
Aloha	462,043	2,228	.....	5,836	214[4]	476,904	378,107	98,797[2]
Hawaiian	561,167	2,810	.....	67,372	138,833[4]	781,690	806,369	−39,439
CARGO LINES								
AAXICO	.....	.....	2,743	70	883,362	1,423,573	1,248,438	175,135[7]
Aerovias Sud Americana[1]	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger	.....	8,155	1,332,356[2]	.....	1,749,856	3,074,412	2,683,769	546,023
Riddle[1]	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	.....	945,652	1,005,067	907,046	98,021[2]
HELICOPTER LINES								
Chicago Helicopter	120,445	151,749	.....	.....	.....	272,204	230,506	39,252
Los Angeles Airways	30,494	12,874	11,405[5]	.....	437	133,062	128,291	11,887
New York Airways	83,569	3,200	1,316	3,183	.....	289,274	277,111	10,529
ALASKA LINES								
Alaska Airlines	286,428	49,498	825	51,600	328,910	866,997	850,497	1,908
Alaska Coastal	129,137	8,023	.....	10,014	12,895	209,035	198,452	10,583[2]
Cordova	17,704	9,971	.....	8,920	50,715	118,128	103,912	12,566
Ellis	81,800	5,300	9,100[2]	.....	5,500	133,200	117,000	16,200[3]
Northern Consolidated	110,821	39,737	.....	40,460	24,815[4]	272,668	265,666	7,001[2]
Pacific Northern	907,909	65,122	2,836	101,939	1,691	1,235,234	1,075,796	141,696
Reeve Aleutian[1]	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	235,417	50,030	.....	41,027	177,751	575,777	553,408	22,368[2]

[1] Not available. [2] Property figure. [3] Net operating income. [4] Non-scheduled transportation. [5] Includes federal subs idy.
[6] Airline division figures. [7] Net income after taxes. [8] Express & excess baggage.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SHORTLINES

▶ **Aloha Airlines** will add three more Fairchild F-27 turboprop aircraft to its fleet, doubling the number of F-27s it now operates, under a $2,161,500 order placed with Fairchild. Payment will be made through a combination of debt and equity financing. Delivery is slated for February, March and May of next year.

▶ **American Airlines** carried 760,000 passengers 578 million revenue passenger miles during August, for 8% and 20% gains respectively. Air mail ton-miles rose nearly 10% to 1,565,000. Express for the month was 970,000 ton-miles, up 2%.

▶ **British Overseas Airways Corp.** is scheduled to begin de Havilland Comet 4 jet transport service to Johannesburg, South Africa, and Salisbury, Federation of Rhodesia and Nyasaland, on Dec. 1. BOAC expects to maintain scheduled flight times of 17 hr. to Salisbury and 18 hr. to Johannesburg.

▶ **Hawaiian Airlines** reports that it carried almost 64,000 passengers on its inter-island services during August, a 7% increase over the same month of 1958.

▶ **National Airlines** reports an increase of 27% in passenger originations from New York in August over those for the same period of last year. The airline attributed the gain to the new night coach fare and its package vacation trips, which are running 88% above those of last summer. National's passengers traveling through New York during August were reported to be 150% over 1958; air express and freight boardings were up 78% and 25% respectively.

▶ **North Central Airlines** boarded 95,409 passengers during August, a 26% gain over August, 1958.

▶ **Northwest Airlines** carried 171,675 domestic passengers 138,214,145 revenue passenger miles during August for a 9.9% gain in passengers and a 12.3 gain in passenger miles over the same month of last year. Total August domestic and international revenue passenger miles rose 13.7% to 179,772,942, with international passenger miles for the month up 18.8% to 41,558,797.

▶ **Olympic Airways** of Greece has reportedly placed an order with de Havilland Aircraft Ltd. for six Comet 4Bs.

▶ **Qantas Empire Airways** is scheduled to begin Sydney-London Boeing 707 service on Oct. 15.

AIRLINE OBSERVER

▶ Final decision in the Civil Aeronautics Board General Passenger Fare Investigation is drawing near. Voting on the first phase of the case took place last week, and voting on the second and third phases of the case will follow during the next few weeks. Only four members of the Board are participating in the decision since Louis Hector has decided against voting because of his resignation from the Board.

▶ **Trunkline business continued its steady climb in August with a 14% increase in revenue passenger miles compared with August, 1958. Load factors climbed 3.31 points to a healthy 66.47 despite an 8.3% increase in available seat miles over the previous August. Thus far this month, there has been no indication that this upward trend will be cut short by the effects of the steel strike.**

▶ Air Line Pilots Assn. has filed an application with the National Mediation Board requesting a "class and craft" determination of flight deck crew members flying on United Air Lines. Purpose of the application is to establish status of pilot-qualified flight engineers to determine whether they come under the jurisdiction of ALPA or Flight Engineers International Assn. United's contract with ALPA specifies that all engineers be pilot-qualified.

▶ **Trunkline common stock listed on the New York Stock Exchange continued to react to a steadily declining securities market. United and Western airlines showed the greatest strength in resisting market sell-offs, but the majority of other airline listings were weak. Both Capital and National reached new lows for the year.**

▶ Watch for another bid by KLM Royal Dutch Airlines for additional routes in the U. S. Chief goal this time will be authority to extend routes to the West Coast.

▶ **Russia's twin-engine An-14 Pchelka (Little Bee) light transport, originally planned to go into scheduled short-haul service on Aeroflot routes last year, was still undergoing factory tests as late as August. Quantity production of the seven-place An-14 won't start until government acceptance tests—"due to begin before long"—are completed. A year ago, the Russians announced that the An-14 "is finishing its last tests."**

▶ Federal Aviation Agency reports a 4% increase in the number of active civil aircraft as of Jan. 1, 1959, compared with the same date last year. Latest figures show that there were 69,718 civil aircraft registered with the FAA in January against 67,153 in January, 1958. California had the largest number of aircraft, but states with the lowest population density have the highest aircraft ownership per capita. They average one or more aircraft for each 1,000 persons.

▶ **Trans-Canada Air Lines and British Overseas Airways Corp. are conducting exploratory talks aimed at a pooling of the two carriers' transatlantic equipment on the Montreal-London route. If talks are successful, such an arrangement would begin sometime in the spring of 1960, using TCA's Douglas DC-8 aircraft and BOAC's Boeing 707-420 transports.**

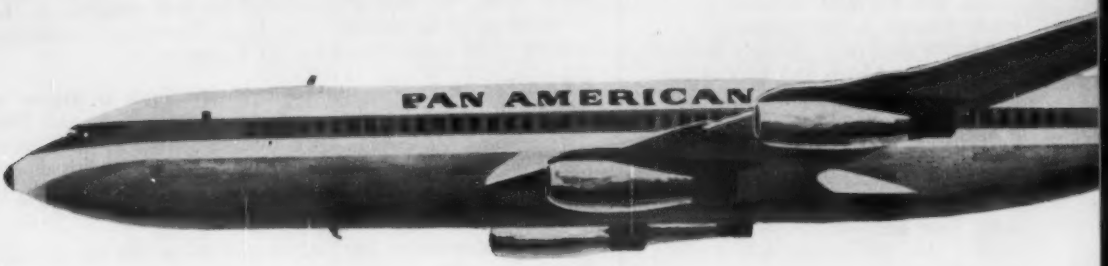
▶ Northwest Airlines sales department has prohibited all sales personnel from drinking alcoholic beverages during working hours, including lunch. The order also cautions against intemperate drinking at public cocktail parties and dinners in the evening when representing the company.

▶ **U. S. flag carriers handled 6.8% of all world-wide international air freight during 1958 as compared with 56.7% carried by Military Air Transport Service, 36.5% by foreign flag airlines. MATS handled 9.8% of all international passenger traffic during the year as compared with 15% by U. S. flag airlines, 75.2% by foreign flag lines.**

▶ Canada and West Germany have signed a bilateral air transport agreement that confirms a provisional pact in 1956 authorizing Lufthansa to fly from Germany to Montreal and on to Chicago. Trans-Canada Air Lines is authorized to operate between Canada and Dusseldorf and beyond to Vienna.

JETS TO THE PACIFIC

HAWAII AND TOKYO

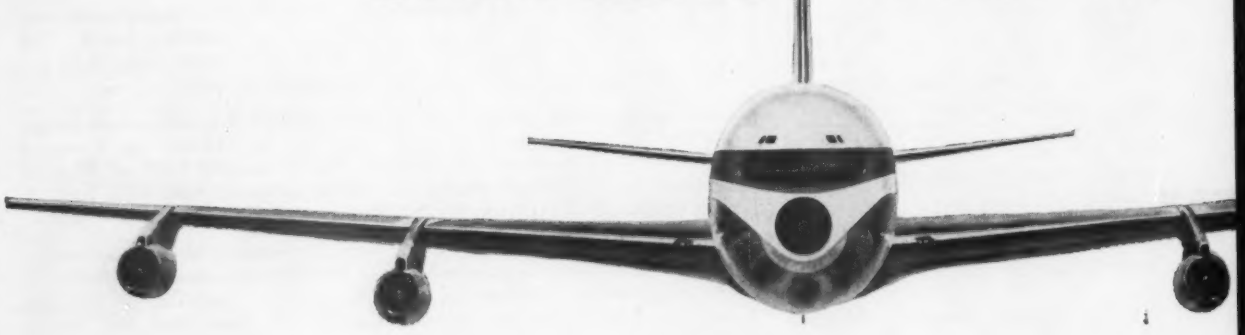


JETS TO EUROPE

LONDON PARIS

JETS TO SOUTH AMERICA

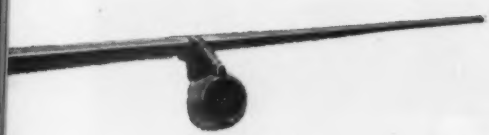
CARACAS | BUENOS



Fastest way to Faraway Places... Pan Am's Jet Clipper Fleet

ROME

AIRES



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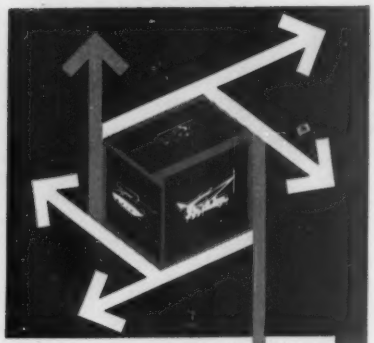

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Los Angeles Expands Its Airport

Los Angeles—Expanded and improved facilities are well under way at Los Angeles International Airport (AW Dec. 1, 1958, p. 38). The $46 million project is scheduled for completion by Mar. 1, 1961, although some facilities, as they are completed, will be phased into use as soon as practicable. Order in which major projects will be completed:

• **East-west runway and taxiway** lying to the northwest of the two active parallel runways now in use will be open Sept. 1. New runway, 8,925 ft. in length, will be used almost exclusively for takeoffs by conventionally powered aircraft. Airport officials said that the strip will be used for landings only in extreme cases. Jet operation is not scheduled from this runway until after completion of the new terminal because of the long taxi distance from the present terminal.

• **Existing Runway 25L** will be closed soon so that it can be lengthened to 12,000 ft. and strengthened for jet operation. Following rework of 25L, Runway 25R will undergo reconstruction and lengthening to 10,115 ft.

• **Now 75% complete,** the new 12-story, 172-ft. control tower will be put into operation.

• **After completion of storm drains** and sewers, construction will start on the new terminal rotunda and the seven satellites for loading and unloading passengers. Satellites will be reached by connecting tunnels from the main rotunda.

• **Airline maintenance facilities,** some of which are already completed and in use, are located to the west of the terminal between the runways.

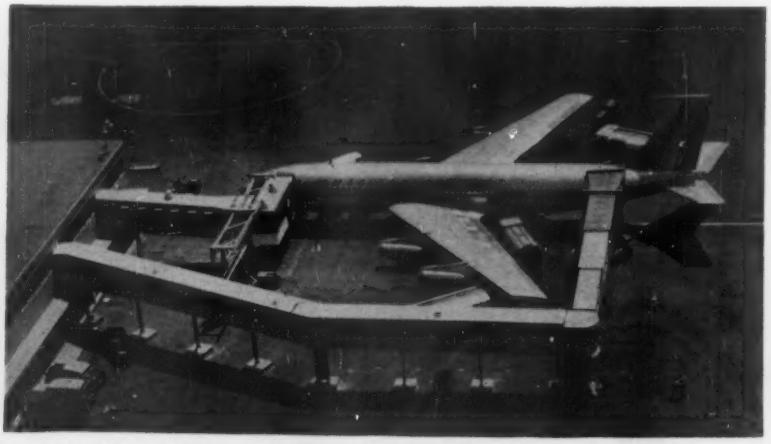
Also included in the project will be rerouting roads and construction of access highways to the terminal facilities.

When completed, the new facilities will permit rapid and easy access for both passengers on the ground and for arriving and departing aircraft. Cross traffic between landing and departing aircraft will be eliminated as well as lengthy holds prior to takeoff when landing density is high. Transports can land, taxi to the terminal, unload and load passengers and depart from the runway on the north side of the field without waiting for a break in the landing traffic.

For the passenger, parking spaces for about 5,000 cars will be provided. Ticketing and baggage deposit will be handled in the central rotunda after which the passenger will proceed to one of the satellites, according to which airline he is using.

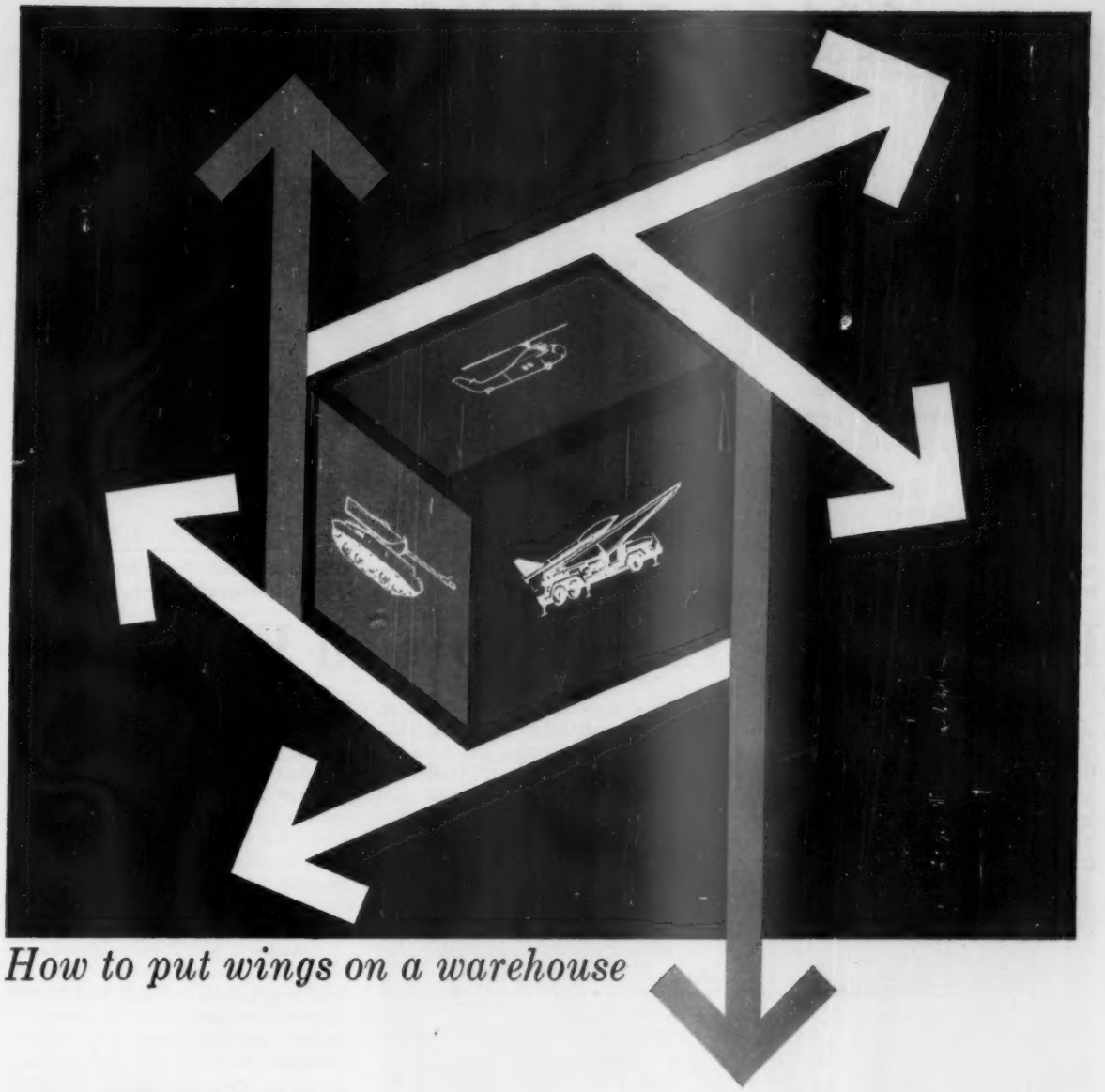
Upswing in passenger traffic this year indicates that approximately five million passengers will arrive and depart from the airport. Don Belding, president of the Airport Commission, said that by 1970, 23 million passengers might possibly pass through the terminal and that it is designed to accommodate this number.

Belding also said that the $59.7 million bond issue voted in 1956 is being retired satisfactorily. In 1960, however, $3.5 million will be required to retire the bonds and pay outstanding interest. Part of the revenue will come by increasing landing fees assessed the airlines. The carriers concerned, he said, have voluntarily agreed to pay the added charges which will mean about a 50% increase in revenue from this source. He said that the original agreements, signed more than 20 years ago, are not realistic in the light of today's airport volume and construction costs.



Jet Boarding System Tested at San Francisco

American Airlines tests boarding system at San Francisco International Airport. System consists of a small gondola on a monorail which fits against Boeing 707-120's forward door, and a wheel-mounted pivoting loader which telescopes against the transport's rear door.

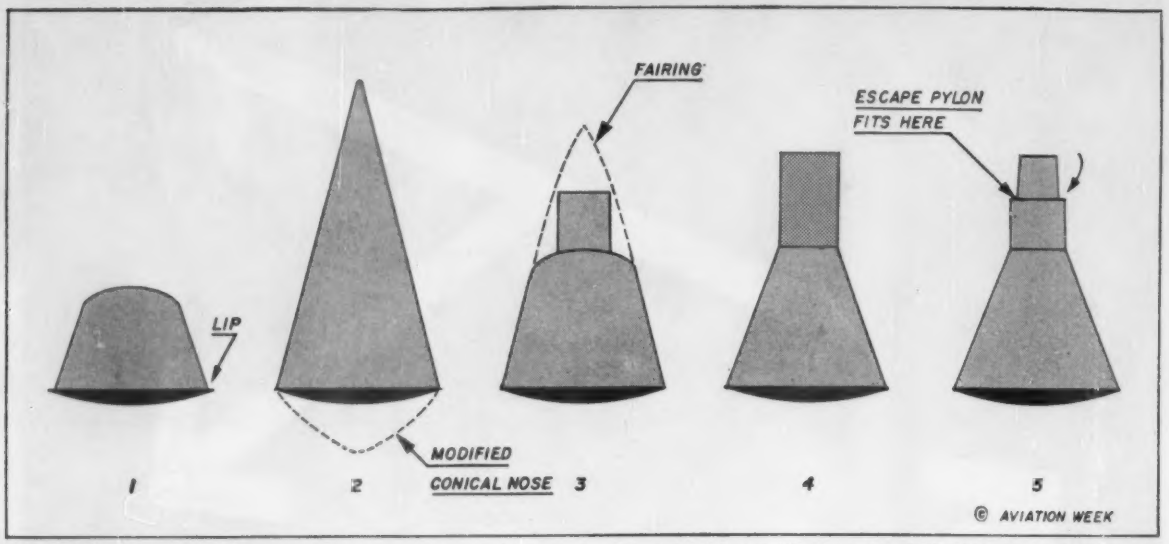


How to put wings on a warehouse

Giving overseas air bases what amounts to local warehouse service on important parts is an Air Force objective. Its present system has slashed delivery schedules up to *20 times*... saved taxpayers several *billion* dollars over the past decade. To improve it further, Douglas has been selected to develop specifications for a comprehensive Material Handling Support System involving better communications, control, cargo handling and loading, packaging and air terminal design. Douglas is well qualified for this program by its more than 20 years in all phases of cargo transport. Air logistics is only one area of extensive Douglas operations in aircraft, missile and space fields in which outstanding openings exist for qualified scientists and engineers. Some are listed on the facing page.

Schuyler Kleinhans and Charles Glasgow, Chief Engineers of the Santa Monica and Long Beach Divisions, go over air transport needs relating to advanced cargo loading techniques with Donald W. Douglas, Jr., President of DOUGLAS

JETLINERS ■ MILITARY AIRCRAFT ■ CARGO TRANSPORTS ■ MISSILE SYSTEMS ■ SPACE SYSTEMS ■ AIRCOMB ■ GROUND-HANDLING EQUIPMENT



MERCURY CAPSULE evolved from simple re-entry shapes (1) to more stable conical shapes (2). Shape in middle (3) was first to allow for internal needs. Shape outlined in NASA specifications (4) was changed by McDonnell to include an antenna canister (5).

How Mercury Capsule Design Evolved

Washington—Little more than a year of intensive effort brought the design of the Mercury manned satellite capsule from primitive beginnings in part time post-Sputnik research to the final configuration now going into flight test with the Little Joe and Big Joe boosters.

When the Soviet Union launched its first two satellites, a few researchers at the National Advisory Committee for Aeronautics facility here anticipated a requirement for a manned satellite capsule and began investigating the shape it should have. A year later, the design was refined enough to submit to industry for bids, and shortly after that it reached the configuration now going into hardware testing.

Capsule Size

Size of the capsule was dictated by the boosters available to launch it, but the most important design feature of the capsule shape from the beginning was its heat shield. This is the vital element that will allow the vehicle and its pilot to survive the 10-11,000F temperatures generated by a wingless body plunging into the atmosphere from its orbit around the earth.

Key to the heat shield design was the re-entry heating technology already developed in the study of ballistic missile warheads. In both the missile and the capsule, as in most flight design, the basic aim was to achieve maximum performance—in this case, heat protection—with minimum weight, since every pound of capsule weight increases the amount of power needed to launch it.

NACA laboratories had done considerable analysis, design, development and testing of blunt re-entry bodies before the first Soviet Sputnik went into orbit on Oct. 4, 1957. Much of this work had been done here at what is now the Langley Research Center.

Research Impetus

In November, 1957, after Russia had put Sputnik II in orbit with the dog Laika as a passenger, it became obvious that both Russia and the U. S. eventually would attempt to put men into orbit and recover them. Although missile re-entry work was well along and much preliminary thought had been given to manned satellites, Laika's venture into space was the real departure point for what is now the Mercury capsule.

Research began with the general notion that the U. S. would soon need an efficient design for a manned capsule. There was no official program, and the work was begun as a part time venture carried along with the regular workload. Central figures in this early work were Max Faget and A. B. Kehlet, who later joined the National Aeronautics and Space Administration Space Task Group, and W. S. Blanchard of Langley's Pilotless Aircraft Research Division.

Primary work on the Mercury capsule shape was done at Langley, and the design steps leading to the present configuration were taken here, although some work in the same area was also under way about this time at the NACA Ames and Lewis research facilities, and similar parallel studies were conducted by the military services.

Research here began before there was any hint that NACA would form the nucleus for the new space agency. It got its first official status in the summer of 1958 when the newly born Project Mercury absorbed the ground work already laid. NASA was officially formed a few months later.

Since then, Mercury has become one of NASA's primary efforts, engaging the full time of NASA's Space Task Group. The program can draw on almost unlimited resources, and total cost is estimated at about $200 million.

Re-Entry Vehicle Shape

NASA chose a blunt, non-lifting shape for its Mercury capsule because it was simpler and faster to develop than more sophisticated approaches. The ballistic re-entry vehicle flies through the atmosphere without lift and depends on drag to slow it to a point near zero velocity where parachutes can be developed for the final flight and landing phase. This concept is more compact and lighter than lifting type vehicles, making it easier to adapt to the Atlas which will boost it into orbit.

A basic purpose in such a design is to get a large drag coefficient and frontal area in relation to weight in order to minimize heating. Early in their general investigation of manned capsule shapes, NACA researchers tried a configuration with a very flat curvature in its heat

VARIETY of Mercury test models include (at left) capsules on Little Joe boosters with their large fins and on Redstone and Atlas boosters. At center are various test models used in development of the capsule shape. Group of large models at right includes an early capsule shape with its tall escape tower, the present shape with its shorter tower and the present shape and tower on a Little Joe boster. At far right is the present capsule design with an early version of the escape tower.

shield and with a squat, domed body designed to approximate the manned portion of the capsule. This fuselage was recessed slightly from the perimeter of the shield, leaving a lip that was supposed to separate the flow off the face of the shield and reduce afterbody heating (Fig. 1).

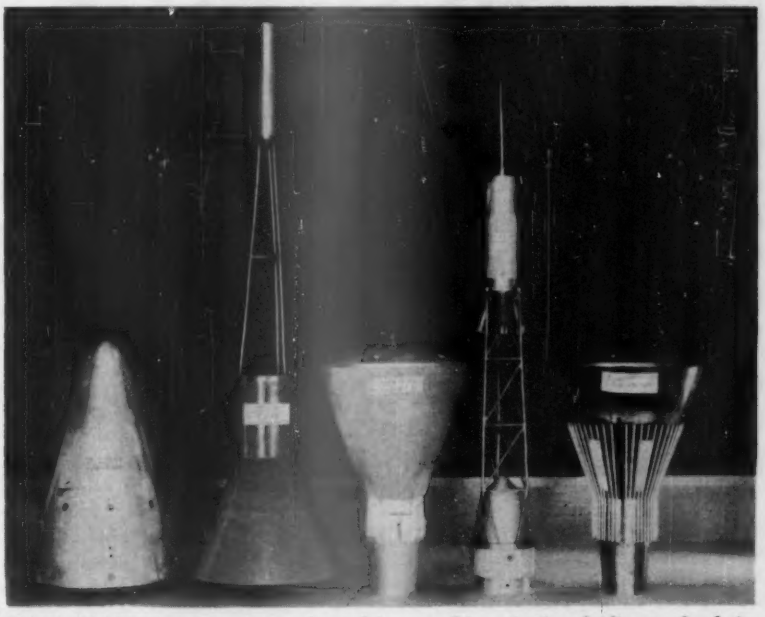
Spin Tunnel Test

This early shape was abandoned during subsonic test in the spin tunnel here when it proved statically stable but dynamically unstable at subsonic speeds. After this period, the capsule shapes tended toward longer fuselage configurations as a means of improving stability. The Mercury capsule will use a drogue chute to provide stability in the transonic and subsonic portions of its re-entry flight, but the shape itself must also be stable in case of a chute failure.

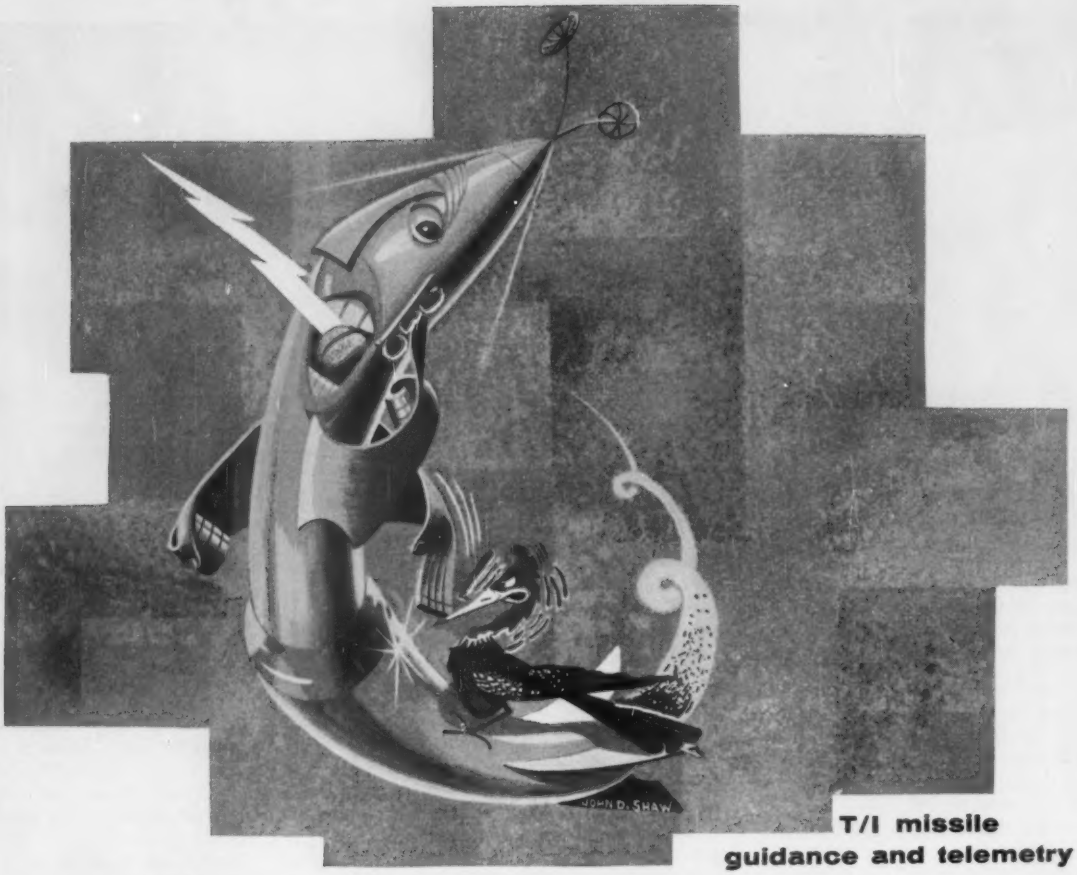
Experimental work in heating problems had already developed considerable knowledge on that aspect of heat shield design, and it was found that a ratio of approximately 1.5 between the radius of the curve and the diameter of the shield face was the best design for minimizing heating on re-entry. Research on what was to become the Mercury shape moved on to that ratio of curvature, and the shield configurations in the latter part of the program were in that general area.

By March, 1958, researchers had moved on to a shape which had a cone mounted behind the heat shield (Fig. 2). Walls of the cone were 12-15 deg. from the vertical, and a long afterbody such as this provided better dynamic stability. During a six month period after this, a variety of such shapes as conical noses (dotted line) and other approaches were tried, but all of these proved to have few advantages and many disadvantages, especially in heating aspects.

At the same time, studies were under way on internal layout and structure, and a new shape was evolved in August taking these factors into consideration (Fig. 3). This shape had a shield with an 80 in. diameter and a radius of curvature of 120 in., applying the 1.5 ratio. A domed structure housed the man in the capsule, and a cylinder was attached to this curved pressure vessel. Length of this cylinder was found to be a critical stability factor. A flow-off cone was



SHAPE AT LEFT is a research capsule used in general investigations leading to the design of the present Mercury capsule. Next is the capsule configuration in the specifications which went out for bids; it has an early version of the escape tower. Middle shape is a test model closer to the present Mercury shape, and next to it is the current version of the escape tower. At right is a model of the Mercury capsule which shows the corrugations used to stiffen the thin walls of the vehicle.



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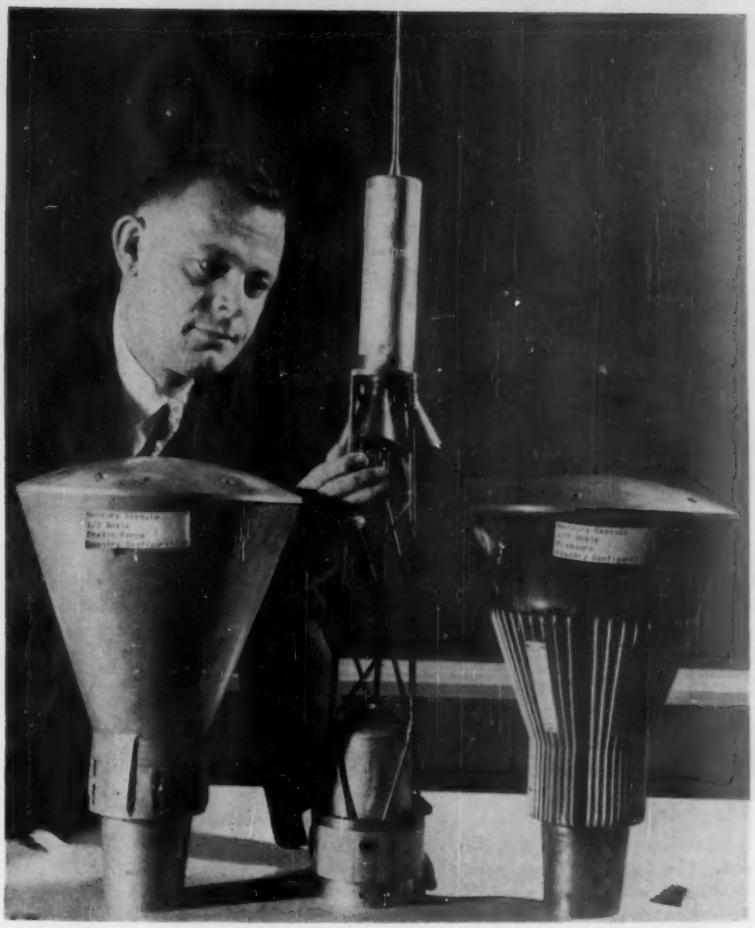


ESCAPE TOWER with its aerodynamic probe is between test models of the Mercury capsule shape. Tower fits over antenna canister and attaches to capsule structure on top of fuselage cylinder. Tower was chosen as an escape system technique to improve stability during launch phase by moving center of gravity forward (away from re-entry heat shield). Tower carries about 60% of its weight in ballast to accomplish this shift.

used to form a drag fairing for the fuselage.

Up to this point, there was no specific escape system concept to fit in with these capsule investigations. Researchers knew such a system would be used, but they didn't know how it would work. Then an escape system was designed, and it involved a tower to be attached to the top of the fuselage.

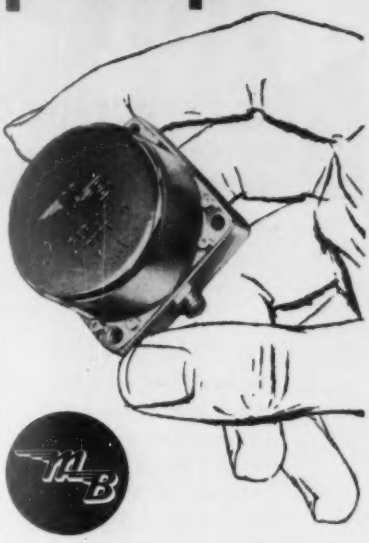
Escape tower fastens to the cylinder on the Mercury fuselage and holds the escape rocket which will carry the capsule away from its booster in case of an emergency. Tower is jettisoned above 200,000 ft. when the vehicle has reached a speed of 7,000 fps., and getting rid of it at this point means the tower can weigh 500 lb. for every 100 lb. of tower weight that would be allowed if the system had to be carried all the way into orbit. Escape tower and rocket will weigh between 500 and 1,000 lb. Capsule without the tower will weigh 2,000 to 2,500 lb.

Basic idea in the tower approach is to improve stability in forward flight during the launch phase by moving the center of gravity away from the heat shield and toward the escape rockets. Then when the tower is jettisoned, the CG moves back near the shield where it is best located for reentry. To accomplish this CG shift, the tower carries about 60% of its weight in ballast.

Jettisonable Shield Studied

Like the tower, the heat shield also was to have been jettisoned at one point to permit inflation of a pneumatic bag which would have absorbed landing shock. This bag has been abandoned in favor of a crushable structure to absorb shock, and the shield is now an integral part of the capsule. Detachable shield approach was considered undesirable for several reasons. The detachment mechanism would have added complexity and presented an added chance of malfunction, especially if it blew the shield off in orbit

Advanced design in a vibration pickup



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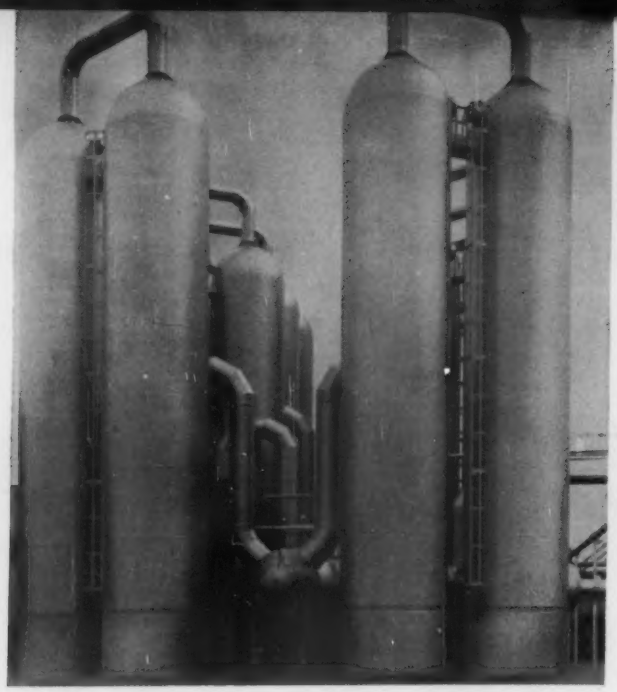

AIR

for supersonic wind tunnel supplied by pressure tanks built of USS "T-1" Steel

It takes vast quantities of high pressure air to create a supersonic wind. These 12 tanks supply air at 600 psi to a 20-inch supersonic blow-down wind tunnel at NASA's Langley Aeronautical Laboratory, Langley Field, Virginia. They were designed and built of USS "T-1" Constructional Alloy Steel by Pittsburgh-Des Moines Steel Co. Each tank is 63 feet high by 11 feet in diameter.

With total volume, pressure and available ground area specified, the problem in this design was to determine the most economical size and number of tanks to do the job. If made of standard boiler steel, the tank walls would have had to be nearly three times thicker than the 1¼" made possible by USS "T-1" Steel. With this three-times-stronger alloy steel, the tank heads are only ⅝" thick, compared with a requirement of nearly 2" thick if made of lower-strength material.

These vessels are good examples of the savings possible with high yield strength USS "T-1" Steel. Much less steel was required; there were vast savings in welding, foundation and volume—and, very important because of space limitations, there was a large reduction in ground area required. The vessels were designed to a working stress of 40,000 psi and 90% joint efficiency. The tensile strength of USS "T-1" Steel for pressure vessel applications is now a full 115,000 psi.

How USS "T-1" Steel saves. These vessels required much less steel than normally used — so there was a sizeable reduction in freight costs. They required less material for foundations. Volume of weld metal was also drastically reduced. And they saved ground space in an area where available space was limited.

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and left the Mercury pilot with no re-entry protection.

Another reason was that in an early drop test, the relatively flat shield fell in a falling leaf pattern after detachment. It glided back and collided with the capsule, presenting an obvious potential hazard for the pilot and his vehicle late in the re-entry cycle.

With the addition of the escape tower, capsule design was shifted to a truncated conical body topped by a cylinder to improve stability in both directions. The conical body provides a flare effect in the launch phase, and the cylinder provides a slight flare effect on re-entry. Choice of a cone also simplified structural problems, since the straight side of a cone is easier to build than a curved body.

At high speeds, the Mercury capsule shape with the tower attached is stable, but this is not true at low speeds. The escape rockets have a thrust misalignment which will make the capsule tumble at low speeds where aerodynamic forces aren't great enough to straighten it out. This is not a problem because the forces imposed by tumbling at these low velocities aren't a hazard.

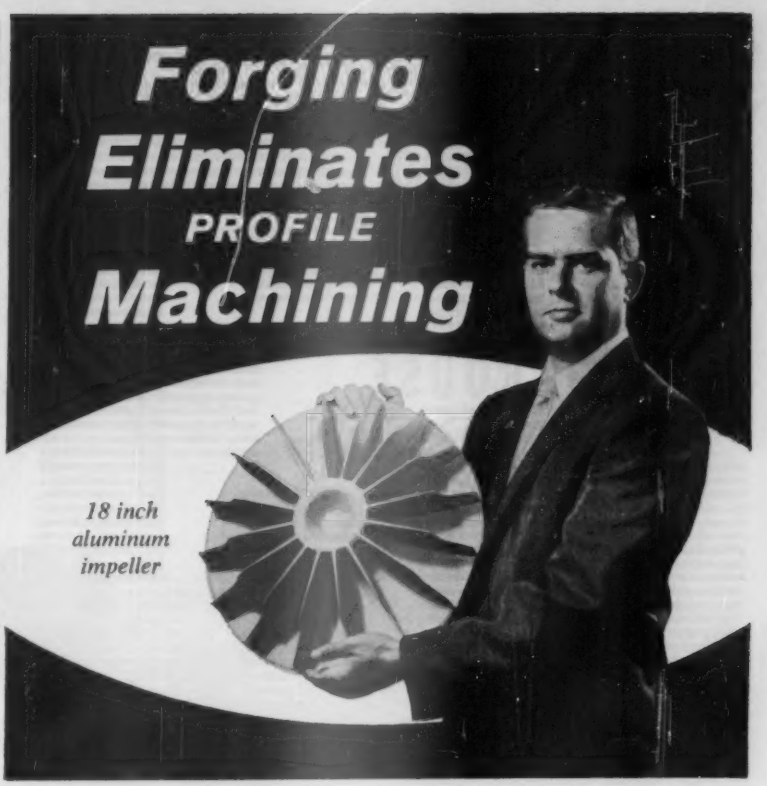
Research Consolidated

During the summer of 1958, NACA (which was soon to become NASA) was working with the Advanced Research Projects Agency to organize the Mercury effort. About that time, the investigations conducted here in the manned capsule area became a part of the Mercury program, and the capsule shape with a conical body topped with a cylinder was the basis for specifications sent out to industry for bids.

Specifications went out for bids last October. Bidders were briefed early in November and asked to get their entries in within a month. There were eight or nine serious bidders out of the 30 companies briefed on the project. Bids were in by mid-December, and NASA moved quickly to a decision, announcing McDonnell Aircraft Corp. the winner in January.

The Mercury shape in the original NASA specifications had a 9.5 ft. fuselage measured from the face of the heat shield to the top of the cylinder and excluding the escape tower and the retrorocket pack on the face of the shield. The shield had an 80 in. diameter and a 120 in. radius of curvature, applying the 1.5 ratio. Later, NASA dropped this radius to 80 in., moving away slightly from the optimum ratio for heating in order to improve stability by moving the CG toward the face of the shield.

McDonnell's winning configuration modified the NASA specification model by shortening the constant-section cylinder on the fuselage and adding a



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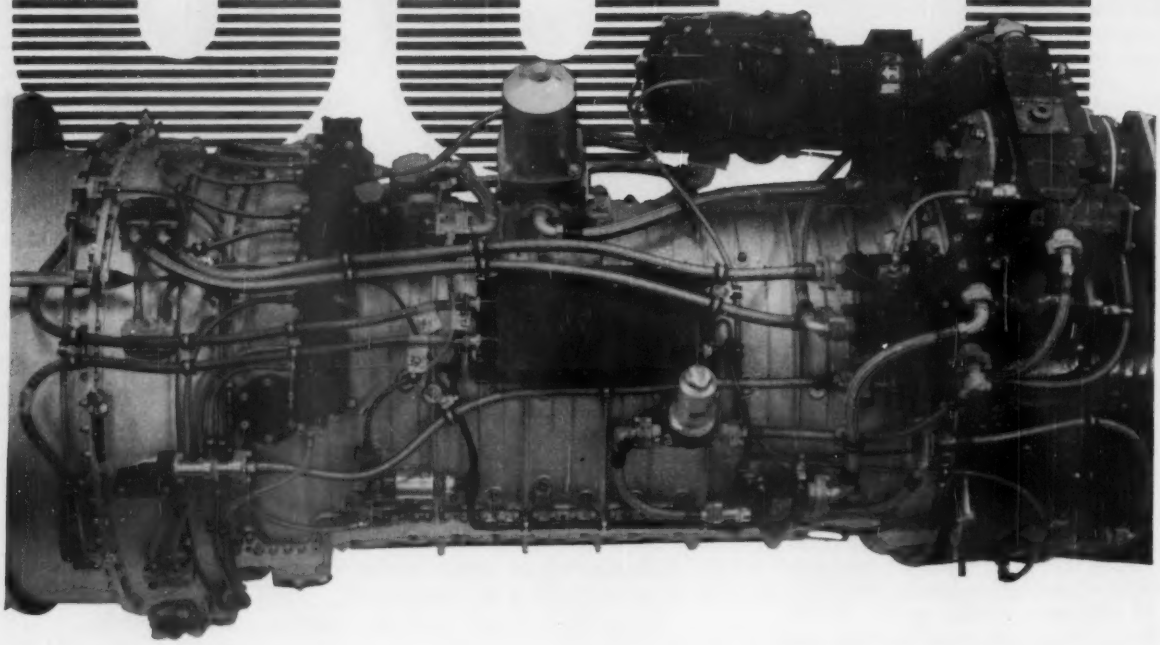

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truncated cone to bring the fuselage up to the required length. This truncated cone at the end of the fuselage is an antenna housing, and it is electrically insulated from the rest of the capsule. This canister also contains the drogue chute, and it is jettisoned along with the drogue chute when the main parachute opens.

The canister is not a structural part of the capsule, and the escape tower fits down around it to fasten to the main structure on top of the cylinder. With the tower attached, the Mercury capsule is 21 ft. long, excluding the retrorockets and the aerodynamic probe on top of the escape rocket case. Early full-scale models of the capsule used for air drop and escape system tests were in the original NASA specification configuration, but now all research and development models are in the McDonnell configuration.

Redstone Booster

At about the time specifications were going out to industry, NASA began to confer with the Army about using the Redstone missile as a booster in the Mercury test and training program. Redstone has a 72 in. diameter, and the greater diameter of the Mercury heat shield was expected to cause stability problems. Army wanted NASA to reduce shield to size of the Redstone.

NASA compromised by reducing the shield diameter from the 78 in. size on the McDonnell capsule to 74.5 in. Pressure vessel in the McDonnell design was smaller than the shield, so shield diameter could be cut to that size simply by following the curve of the pressure vessel.

The very blunt shape of the Mercury capsule has a negative lift coefficient. This shape minimizes oscillations, and it is fairly easy to trim with reaction control jets. On re-entry, the Mercury pilot will want to keep his attitude at a zero angle of attack to avoid getting any lift. With negative lift, tipping the capsule downward would produce lift and cause the vehicle to overshoot its landing area. Another technique the pilot will use to minimize landing area dispersion will be to tilt the capsule upward 30-45 deg. from orbital attitude when firing his retrorockets in order to neutralize any misalignment in rocket thrust.

Reaction control system will be used to rotate the capsule slowly during re-entry, probably at about 1 rpm., to neutralize instability which might be caused by any slight shift in CG. NASA investigated the chin flap as a means of trimming and controlling the vehicle and found it could be used on a capsule with the Mercury shape, but the decision was made to rely on the reaction control system.

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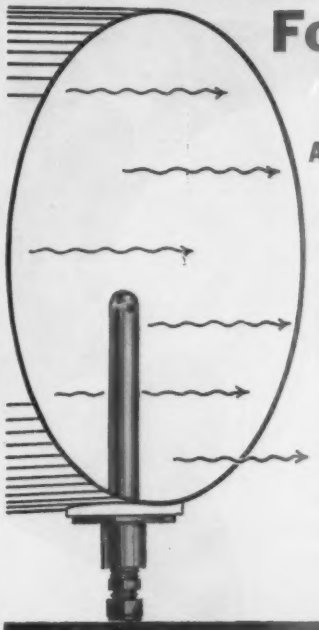

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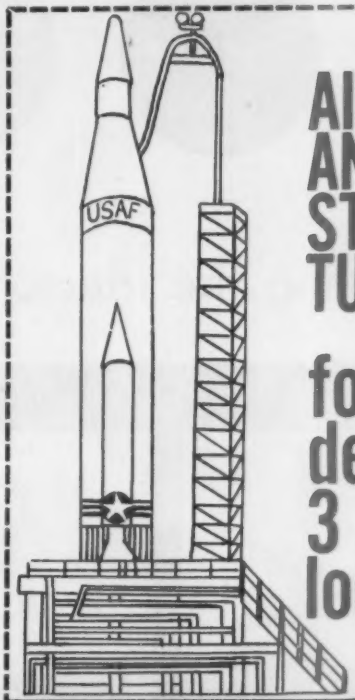

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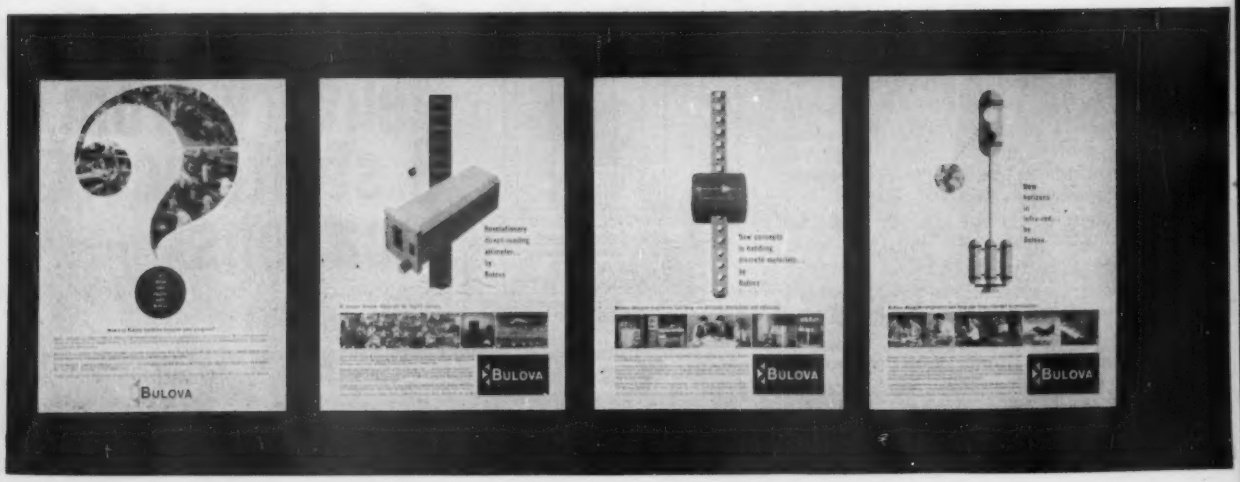

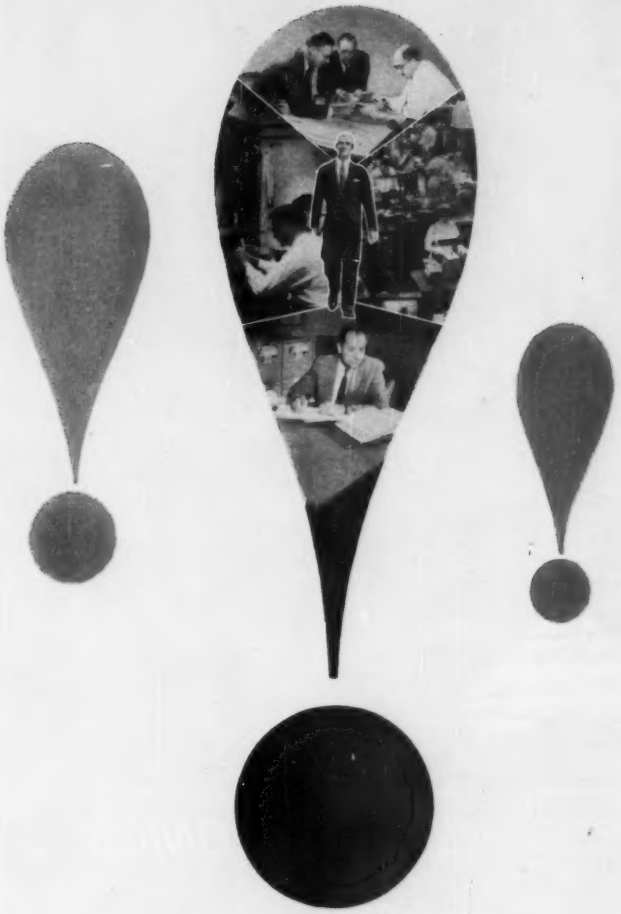

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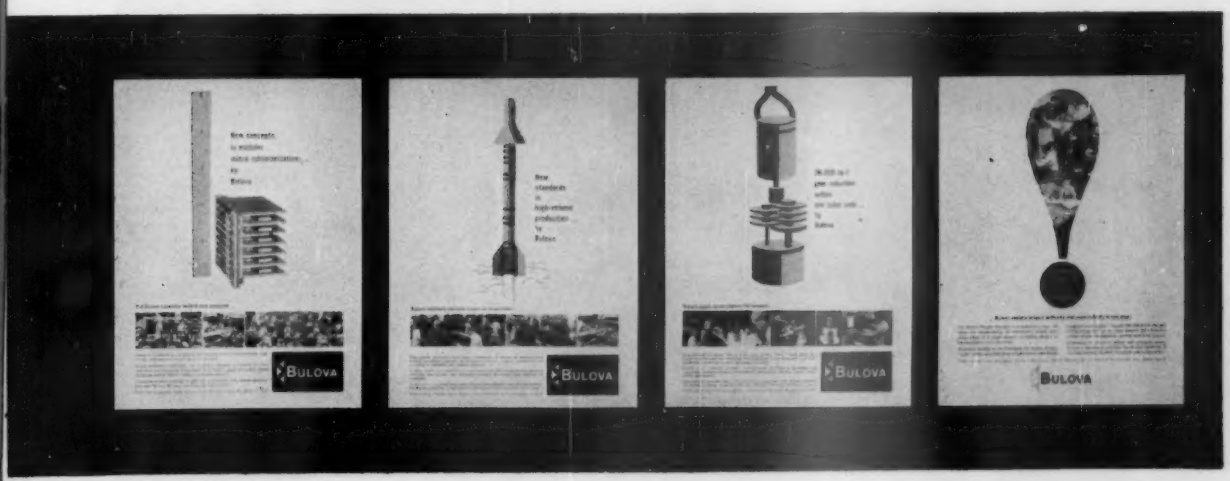

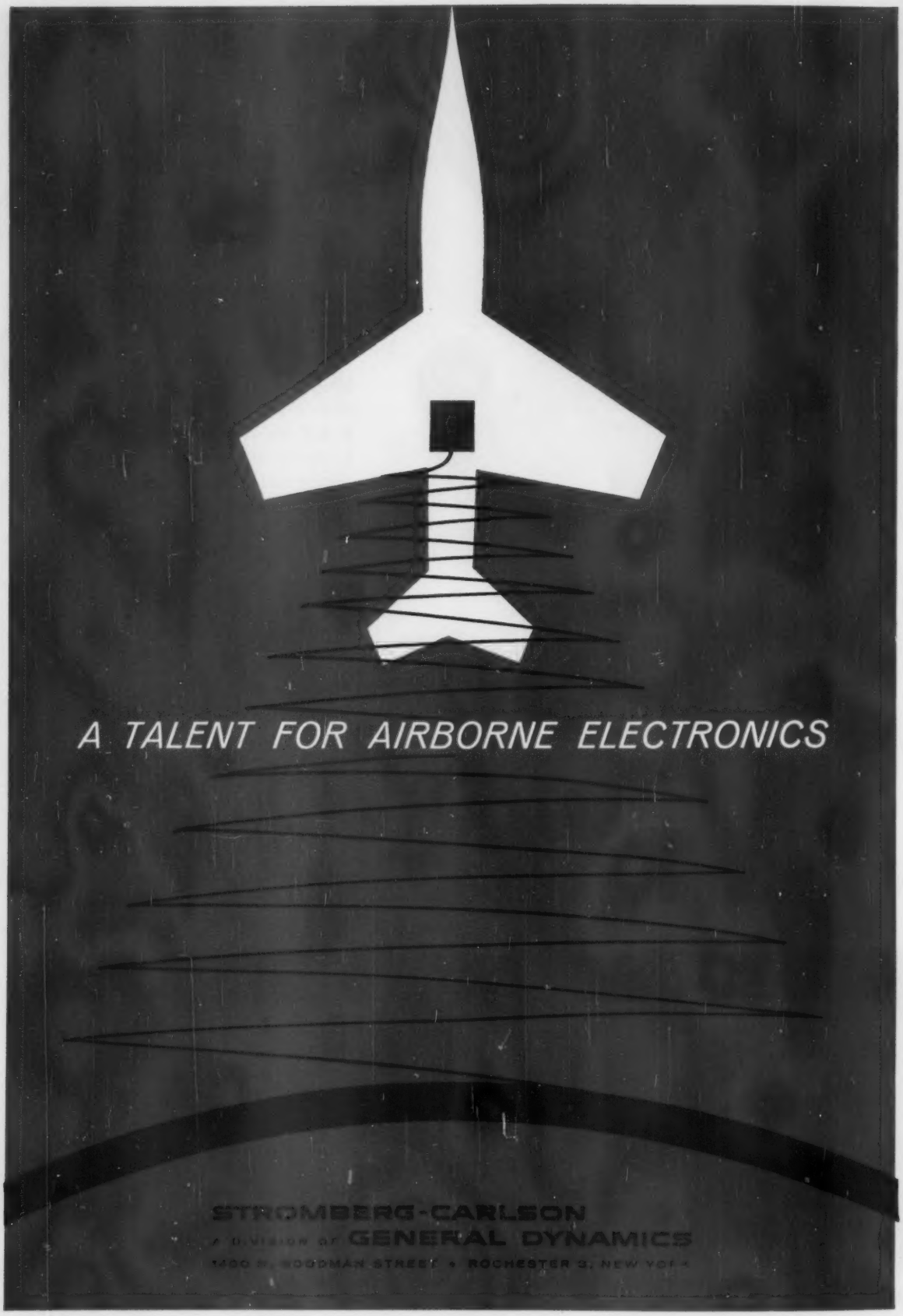
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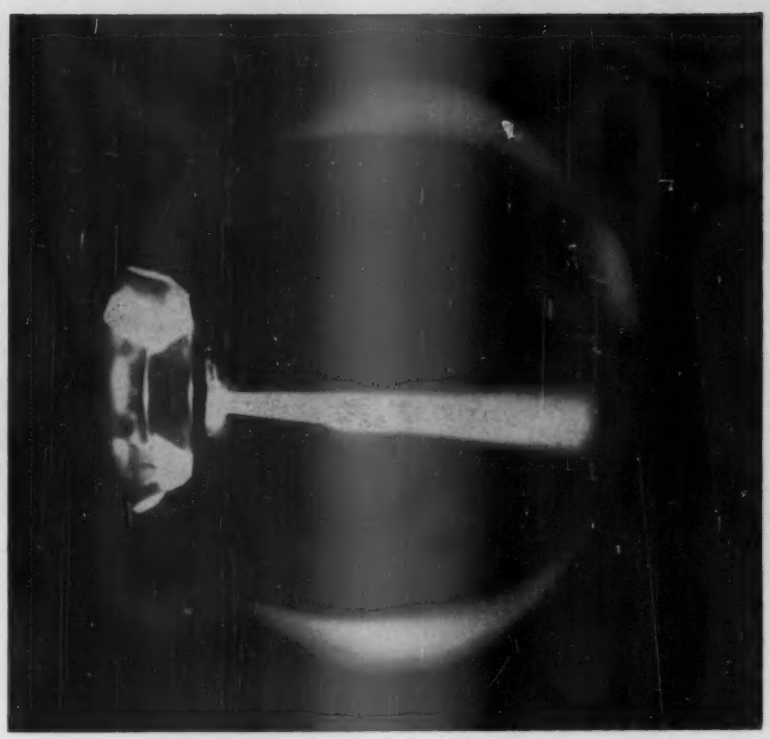

Experimental Ion Engine Tested

Prototype ion engine, here photographed in operation through a port in top of a vacuum tank, has been developed by Rocketdyne Division of North American Aviation, Inc. Ion source for the experimental engine is cesium, which is heated to vaporization, then ionized and accelerated through a high-gradient electric field to produce thrust.

Navy Skyhook Balloon Studies Anti-Protons

Washington—Navy Skyhook balloon carried scientific instruments to an altitude of 150,000 ft. earlier this month in an attempt to find out whether there are anti-protons in cosmic radiation.

The balloon held specially prepared photographic emulsions near peak altitude for eight hours to record cosmic radiation and to see whether the radiation contains anti-protons. Experiment was jointly sponsored by the Office of Naval Research, Atomic Energy Commission and the National Science Foundation.

It was directed by Dr. Marcel Schein of the University of Chicago Physics Dept.

Basic aim in the anti-matter experiment was to take measurements above most of the earth's atmosphere, since anti-protons are likely to be quickly filtered out of cosmic radiation by contact with the atmosphere. The balloon carried its instruments above 99.85% of the earth's atmosphere, and researchers hope any anti-protons present could slip through to that point. It will take several weeks to analyze results, however.

The 6 million cu. ft. polyethylene balloon used in the experiment was made by Raven Industries. It was fabricated from 96 gores of 0.5 mil material and weighed 450 lb. The 48 lb. payload of controls and scientific instruments was suspended under the balloon. After eight hours at an altitude of almost 150,000 ft. the payload was cut loose and returned to earth by parachute. Balloon was launched from Sioux Falls, S. D.

Minuteman Telemetry Contract Awarded

Danbury, Conn.—Ground station telemetry system for the Minuteman solid-fuel intercontinental ballistic missile test program will be developed by Data-Control Systems, Inc. The company has received a subcontract award of $750,000 from Boeing Airplane Co., prime contractor for Minuteman, for the FM/FM ground installations for the test program for receiving, monitoring and recording of telemetered data during the missile's countdown. The data gathering and processing system will be used during the research and development phase of the Minuteman program.

AIR SURVEILLANCE Room of Mitre Corp.'s direction center for its Evaluation SAGE Sector where integration of SAGE system and civil air traffic control will be studied in Satin program. SAGE-type tracking consoles will be used initially.

SAGE, ATC Integration to Be Studied

By James A. Fusca

Lexington, Mass.—Integration of air defense and air traffic control by the mid-1960s is being planned by USAF and the Federal Aviation Agency. Air Force and FAA contracts are being negotiated with the non-profit Mitre Corp. for the design and operation of an experimental facility to test all of the air traffic control functions of the integrated centers. The Mitre program is called Satin, for SAGE air traffic integration.

The FAA is requesting authority from the House and Senate Appropriations Committees to spend uncommitted funds on installation of equipment at the integrated centers.

The plans for centralizing integrated facilities have been developing over the past 18 months. An earlier experimental program called Charm (for CAA high altitude remote monitor), begun by Lincoln Laboratory for USAF and transferred to Mitre when the new corporation was organized, demonstrated the feasibility of using the SAGE air defense system to assist the present air traffic control system. Based partly on the results of the Charm studies, a plan has been drawn up for integrating and centralizing the two systems at the nine super combat centers being constructed in the United States for the SAGE system. A 10th super combat center to be built in Canada may include integrated air traffic control facilities.

Key to the integration is the large-capacity AN/FSQ-7A transistorized computer being designed for installation at the super combat centers. This improved computer will enable the centers to fulfill their air defense mission while providing en route, high altitude air traffic control: maintaining positive separation of aircraft and permitting direct, area, and airways flying. During the first stages, only aircraft flying above 24,000 ft. will be controlled, but this limit will be lowered as information on the capacity of the system in operation is obtained.

SAGE and ATC Tests

When planning for air defense-air traffic control integration at the super combat centers began, the need was recognized for an experimental facility where the concepts, techniques, and design of such a complex system could be thoroughly tested.

The Satin program has been started by the Mitre Corp. to design and implement a facility for this purpose and, additionally, to obtain experimental data on related problems such as the capacity of a control team, length of computer programs, and adequacy of data displays.

The first detailed information on the plan for integrating the two systems and on the Satin program is in a report by David R. Israel of the Mitre Corp. who directed the Charm program, first as Group Leader of Group 66 (Special Studies) at Lincoln Laboratory and later as the head of Department 16 (Special Studies) at Mitre. Israel has worked both with FAA and USAF in developing the concepts of an integrated system.

He is delivering the report this month before the third Avionics Panel of the Advisory Group for Aeronautical Research and Development of North Atlantic Treaty Organization, being held at Aachen, Germany.

By late 1958 the Charm experiments had proved successful. Coincidentally, the initial SAGE installations had become operational and their successful use of centralized data processing by high-speed digital computers had brought a general realization that these techniques offered the most promising solution to the en route traffic control problem. At this time the Air Force announced that the faster and improved AN/FSQ-7A solid-state computer would be developed for installation at the super combat centers to increase the data processing capacity of the SAGE system on a nation-wide basis.

Based on these developments, early this year the FAA and the Air Force in collaboration with Mitre undertook the joint planning for integration of air traffic control and air defense functions

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at the super combat centers. Principal elements of the plan are:

• **Collocation.** Collocation of these integrated functions at the super combat centers will permit common use of the radar and beacon inputs from both FAA and Air Force radars as well as the joint use of the SAGE data processing capabilities. Each will maintain its organizational integrity within the center, with FAA control teams and supervisory personnel using separate display consoles and operating areas.

• **Coincident control areas.** The control aspects of the integrated system will be limited to en route traffic, particularly at the altitude above 24,000 ft. In less dense traffic areas control will eventually extend to lower altitudes, possibly to the ground. The boundaries of the nine U. S. en route traffic control areas will coincide with the corresponding air defense boundaries to permit efficient integrated use of air defense and air traffic control radars, communications, and computer programs, as well as reducing coordination problems between the two systems.

• **Positive separation.** The air traffic control function planned at the super combat centers will stress the maintenance of positive separation of all air traffic under control, while at the same time making the most of the available air space. Positive separation under instrument flight rule and visual flight rule conditions will be provided for direct, area, and airways flights. Control will not depend on the presence of an airways route structure, but will use such a structure when it defines a route of flight.

• **System inputs.** The basis for the maintenance of positive separation will be input data in the form of flight plans, progress reports, search radar and radar beacon data, and other data sources as they become available. In general, radar and beacon data will be used to provide confirmation and "fine grain" correction to the flight plan data. Flight plans and pilot progress reports will be entered directly into the computer by controllers. These will be online inputs directly into the computer from remote points or locally by flight data entry personnel. Teletype or similar equipment will generate the input signals, in a manner similar to one developed and used in the Charm program. Search radar and radar beacon data will enter the computer for both air defense and traffic control purposes from the AN/FST-2 equipment at the radar sites and the associated communications and computer input equipment.

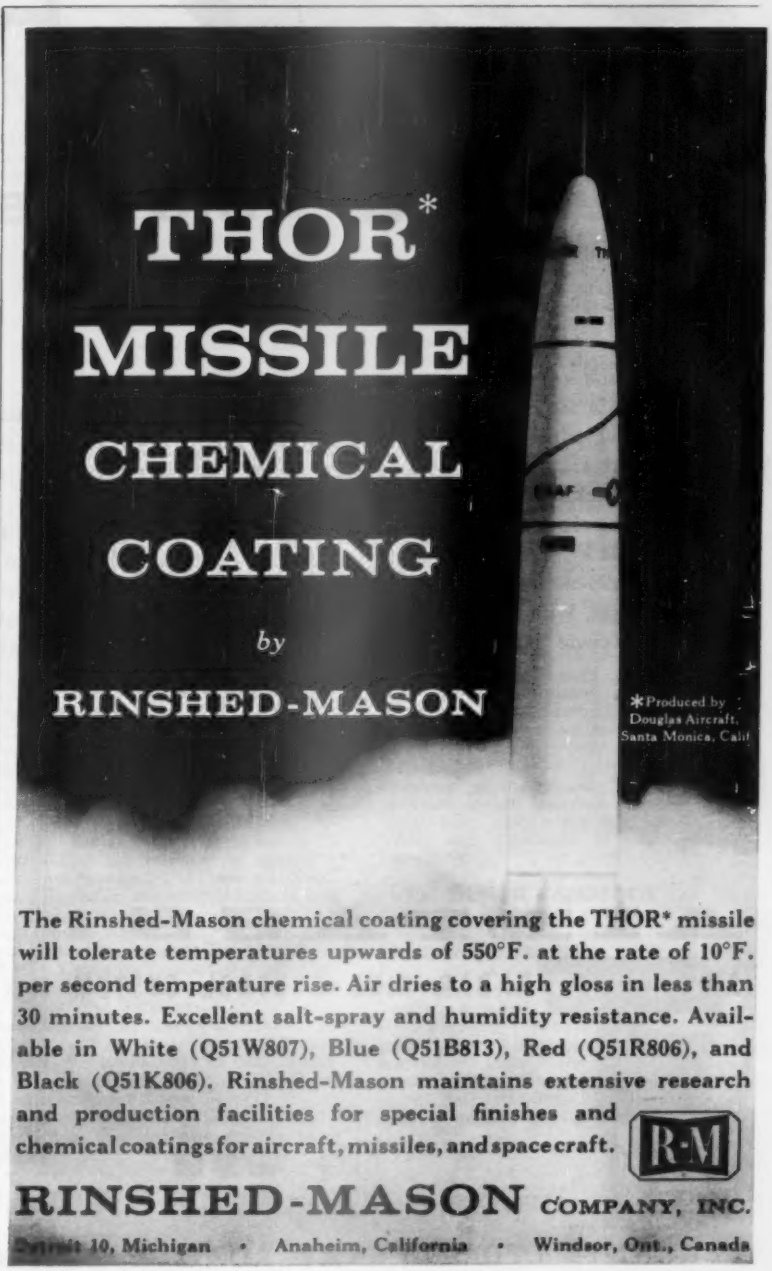
• **System communications.** Control information will be transmitted to aircraft primarily by means of direct controller to pilot ground-air radio. As data link equipment becomes available, it will be tested for automatic ground to air communications and may be incorporated. Coordination information required at adjacent centers will be cross-told automatically where possible, although voice communications may be required for some purposes.

• **Computer programs.** Certain programs of the computer at each center will be used jointly for air traffic control and air defense functions, while others will be useful only to one system. Air surveillance data such as radar inputs, tracking, track display requires programs that are large users of computer time but are common to both systems. Manual input programs involving flight plan processing, winds aloft, and terminal area weather will also serve the purposes of both systems. Programs such as those for missile guidance and air traffic conflict detection will be limited to one function.

Program Functions

The basic computer program functions that will be required to provide en route air traffic control will be:

• **Flight data entry** will include the processing of flight plans, progress reports, and weather data into system tables necessary for control purposes. Input messages will be decoded and subjected to error detection processes. Notification of acceptance or rejection



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of input data will be transmitted to the source automatically through computer output.

• **Flight progress maintenance** will involve the computation of aircraft position and velocity based on flight plan as well as radar and beacon data available in the joint air surveillance system. Computed flight plan position and velocity will be adjusted by pilot-reported progress and the track of the aircraft obtained from radar and beacon data. The automatic radar tracking function of the computer will be aided by the advanced knowledge of intent contained within the flight plan.

• **Control for separation** function of the computer will predict conflict situations, making use of previously determined aircraft position and velocity. Additionally, aircraft position, velocity, and intent will be displayed to control personnel.

• **Flow control** processing will utilize information available on terminal acceptance rates to direct traffic so that the rates are not exceeded. Traffic within the en route center area will be analyzed by destination and compared with terminal acceptance rates. The results of the computation will be made available to flow control personnel for use in adjusting traffic flow.

Control Teams

Air traffic control consoles at the super combat centers will be manned by FAA personnel. The consoles will be similar to those used in the SAGE system with both plan position indicators and tabular displays. The pictorial displays will be selectable in that they will be capable of expanding a sector or displaying targets only at selected altitudes. Information presented to a controller today on flight progress slips will be available in several different formats on the tabular displays. The controller will enter information into the computer through a keyboard.

The control of traffic over a given en route area will be the responsibility of a control team composed of two or more controllers and assistants. One operator in the control team will monitor the processing and matching of radar, beacon, and flight plan data, although the computer will perform automatic tracking. It may be desirable to have this operator make the initial match or correlation.

A second controller of the team will be responsible for monitoring the control process. Where possible, standard data processing functions and decisions will be made by the computer. Operating personnel would take over only in unusual circumstances as, for example, to resolve a computer-detected conflict.

The exact number of control teams per super combat center is as yet unde-

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by A. N. DANIELS, *President*
New Hampshire Ball Bearings, Inc.

WHY CLASS ABEC 7 BEARINGS?

Improved Running Quality in critical applications is the reason why the Annular Bearing Engineers Committee of the Anti-Friction Bearing Manufacturers Association, Inc., has established Class 7 as the highest United States standard for manufacturing tolerances of miniature ball bearings. Originally available only on order . . . and at premium prices because of selection from ABEC 5 production runs . . . ABEC 7 bearings are now offered by New Hampshire Ball Bearings, Inc., as its minimum standard . . . at no extra charge.

An item-by-item comparison of ABEC 5 and ABEC 7 standards clearly shows how closer tolerances improve running quality.

(COMPARATIVE CHART)

RING		MEASUREMENT	TOLERANCES ABEC 5	TOLERANCES ABEC 7
Both	1.	Radial Runout (TIR) Max.	.0002"	.0002"*
Inner	2.	Side Runout with Bore	.0003"	.0001"
Outer	3.	O. D. Runout with Side	.0003"	.00015"
Both	4.	Parallelism of Sides	.0002"	.0001"
Inner	5.	Groove Parallelism with Sides	.0003"	.0001"
Outer	6.	Groove Parallelism with Sides	.0003"	.0002"
Inner	7.	Bore (I.D.)	+.0000" −.0002"	+.00000" −.00015"
Outer	8.	O.D.	+.0000" −.0002"	+.0000"** −.0002"**
Both	9.	Width (Individual Rings)	+.000" −.005"	+.000" −.005"***

*ABEC 7 allows .0002" radial runout for outer ring. We hold it to .0001".
**We hold it to −.00015"
***We hold it to −.001"

Radial Runout . . . the sum of a ring's out-of-roundness and eccentricity . . . is functionally important. In critical high-speed applications, it affects balance and true running. In precise gear trains, it affects backlash and sometimes angular velocity ratio. In closely designed synchros and similar electrical equipment, it affects air gap control. Since most bearings operate with inner ring rotation, you'll notice that ABEC 7 cuts the ABEC 5 allowance in half . . . from .0002" max. to .0001". For the outer ring ABEC 7 makes no change from Class 5's .0002" max. However, modern race grinders work to a nominal zero runout and .0001" max. may usually be expected. Our inspection tolerance, therefore, is .0001". This gives outer-ring rotation applications the same advantages as for inner-ring rotation.

Perpendicularity of raceway planes to axis of rotation is a highly desirable feature. Its probability is determined by the interrelationship of Side Runout with Bore (Inner Ring), O. D. Runout with Sides (Outer Ring), parallelism of sides and groove parallelism with sides of both rings, when bearings are properly mounted and seated. If raceway planes are not perpendicular to the axis of rotation, stresses and torque peaks will be developed within the bearing because of this misalignment unless radial clearance and enlarged raceway curvature are sufficient to compensate. This effect may be observed in clamped, preloaded duplex bearings by shifting the relative position of the rings, reclamping and feel-testing.

Notice that the five perpendicularity features (2 through 6 in the chart) have much lower allowances in ABEC 7 than in ABEC 5. These differences in angular inaccuracy mean much in running quality as bearings become smaller. For example, non-parallelism of .0002" on a ⅜" O.D. (R 2 bearing) represents an angular error of about 2 minutes. But, on a 3/16 O.D. (R 1 bearing), the same allowance means 4 minutes of angular error. That's why ABEC 7 reduces allowances by one half or more. The importance of minimizing angular error is also reflected in the AFBMA tables of allowances, which are generally reduced within each class as size of bearing is reduced.

Envelope Tolerances (7, 8, and 9 in the chart) make little or no difference in running quality. The only ABEC change is from bore tolerance of plus 0, minus .0002 in Class 5 to minus .00015 in Class 7. This permits mounting bearings to a narrower spread of fits. Although ABEC 7 allows the same O.D. and width tolerances as for ABEC 5, we have reduced O.D. tolerance to plus zero, minus .00015" and, together with other manufacturers of instrument bearings, have reduced width tolerance to minus .001. The latter minimizes variation in axial spacing of assemblies.

Other Factors that affect running quality of bearings are not covered by ABEC standards. They include: truth of raceway geometry, surface finishes, retainer design and finish, radial and axial play and some ball qualities. These are discussed in our design handbook.

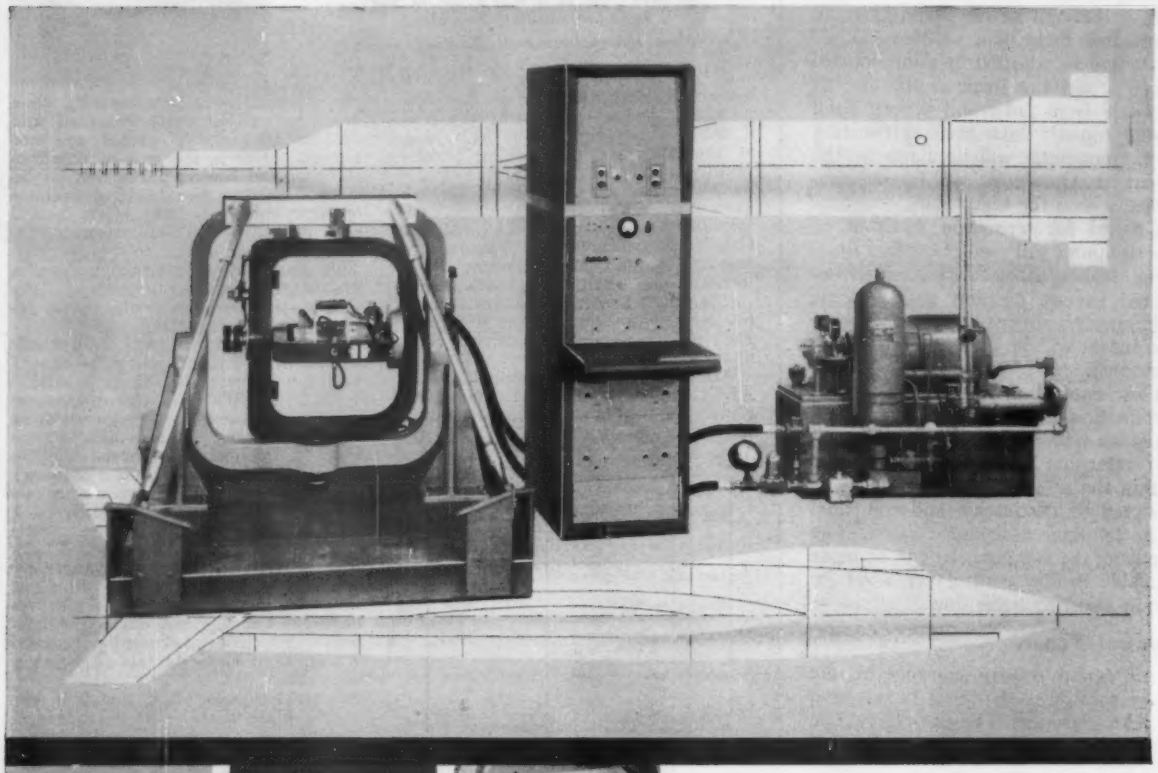
DESIGN HANDBOOK OFFERED FREE

You'll find this up-to-the-minute, authoritative 70-plus-page publication a great help in designing instruments or small electromechanical assemblies. Write to New Hampshire Ball Bearings, Inc., Peterborough 1, N. H.

NEW HAMPSHIRE BALL BEARINGS, INC.
PETERBOROUGH, N. H.

THREE-AXIS FLIGHT SIMULATION

assures sytem accuracy and stability



Direct hydraulic drive, free from gear noise, produces exceedingly smooth motion from rates as low as the earth's rotation to velocities and accelerations considerably higher than those encountered in modern, high-performance aircraft and missiles.

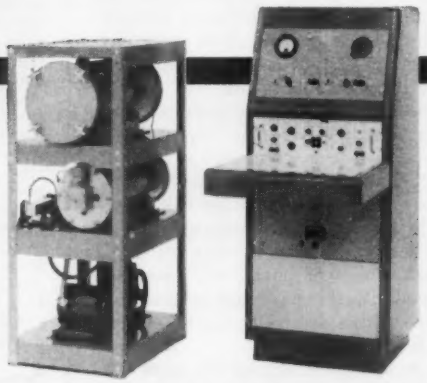
By creating the same dynamic motions met in high-performance aircraft and missiles, the CTI Three-Axis Flight Simulator enables accurate analyses of flight control systems and inertial guidance platforms to be made in the laboratory.

Any conventional analog computer can be used with the Flight Simulator for combined programming and system analysis. Computer (or other signal source) voltages representing a pre-determined flight path are accurately translated into roll, pitch, and yaw positions, velocities, and accelerations by means of a position-feedback servo system. Superior performance with large-volume, high-inertia loads is achieved at minimum cost and maintenance by the unusual simplicity of design.

Only the use of actual control components under identical flight-motion conditions can enable a laboratory evaluation to assure flight performance. Write for complete technical specifications.

DYNAMIC ALTITUDE SIMULATOR

Available separately or as a companion unit to the Three-Axis Flight Simulator, this Altitude Simulator reproduces dynamic altitude changes through a bandwidth of ±700 feet with a frequency response of 10 cps. Operating range is sea level to 80,000 feet.



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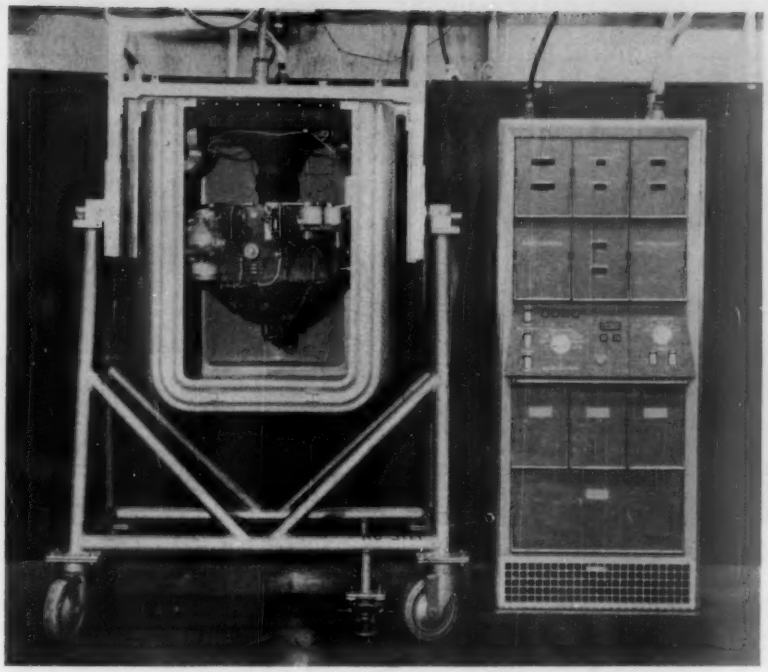


Polaris Submarine 'Autonavigator'

First photos show inertial guidance system for steering Polaris missile-firing submarines to undersea launch sites. Stable platform, gyros and velocity meters are grouped at left. Autonetics Division of North American Aviation, Inc., is the manufacturer.

cided. It will depend upon the number of aircraft to be controlled and the capacity of the control system. Traffic estimates are now being made on the basis of current traffic, growth trends, changes in aircraft characteristics, and related parameters. First estimates indicate peak traffic loads of 200-500 aircraft under control by each center at the peak hour of a busy day. The capacity of each control team is estimated as 10-20 aircraft at one time, although the final figures for design purposes will be obtained as part of the Satin program.

Satin Test Facility

In evaulating this integration plan and the equipment that it requires, Mitre Corp. will use the AN/FSQ-7 (XD-1) computer turned over to it by Lincoln Laboratory. This XD-1 computer is actually one-half of the normally duplexed AN/FSQ-7 installed in SAGE direction centers. The computer, from its location in Lexington, will control a test area approximately 240,000 sq. mi. in size. The area will cover a large part of the northeastern United States including the National Aviation Facilities Experimental Center of the FAA at Atlantic City. The area is comparable to those planned for operational super combat centers.

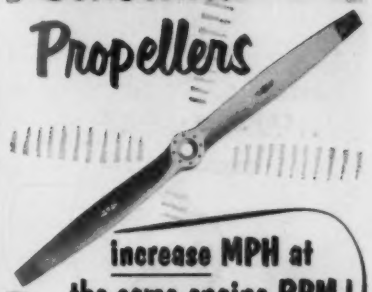
Because the XD-1 computer has less capacity than the AN/FSQ-7A computer to be installed at the centers, Satin will be limited in two respects. A capacity of 100 aircraft is planned, with four control teams and additional supervisory positions. All air traffic control and common functions planned for the super combat centers will be included, but air defense functions independent of air traffic control considerations will be omitted.

Certain modifications of the XD-1 will be required, primarily so that the computer will accept on-line teletype input and generate teletype output. Initially SAGE consoles will be used, supplemented by teletype keyboards for data entry. As the design of new consoles for control personnel is completed, these experimental consoles will be added. The first display console that will be tested is one developed by Stromberg-Carlson that employs an Xerographic display process.

Design of Satin began early this year. Computer programing and equipment modification and installation is in progress. Limited operation of flight plan input and beacon tracking programs is expected early in 1960. Full system testing is scheduled for the fall of 1960. One major problem remains unsolved, and is now receiving considerable attention. This is the problem of testing the system adequately without compromising the existing manual air traffic control system.

The Charm experimental program that provided the basic data upon

Sensenich Propellers



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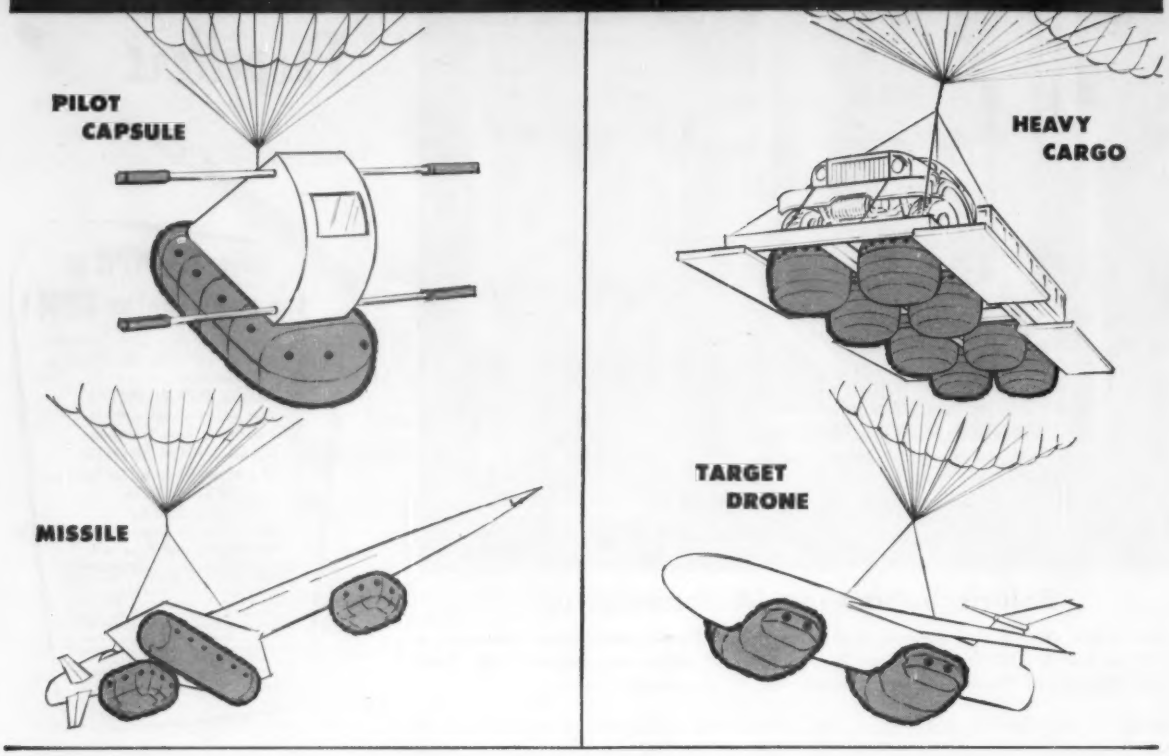
PNEUMATIC RECOVERY SYSTEMS / another product of Air Cruisers research



Solve New Missile and Capsule Recovery Problems

Air Cruisers has nearly a decade of experience in the development, testing and production of pneumatic recovery systems. Beginning with aerial cargo recovery, the company expanded its activities to include deceleration systems for various missile and target drone applications.

Other Air Cruisers system designs include recovery of missile nose cones and component parts, and pilot capsule recovery which enables the crew to land safely in the sealed capsule.

Air Cruisers' recovery systems consist of inflatable deceleration and/or flotation bags specially designed to meet all requirements:

- Provide maximum protection from landing damage
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With these rugged impact bags, you may have your choice of inflation methods, including the proved jet pump method to save added weight and space. Air Cruisers starts with your problem statement and can furnish the complete system. Write for full information concerning pneumatic recovery systems.

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Miniature Tape Recorder

Miniature tape recorder, capable of recording on 1 to 16 channels on a continuous tape, weighs only 10¼ oz., occupies only 14 cu. in. Tiny recorder, developed by Leach Corp., Los Angeles, reportedly can withstand 2,000g shock and consumes only 1¼ w. of electric power.

which the present integration plan is built was begun in January of 1958 by Lincoln Laboratory to demonstrate how the SAGE system might assist the existing manual air traffic control system. The program concentrated upon traffic at high altitude, defined as beginning at 24,000 ft.

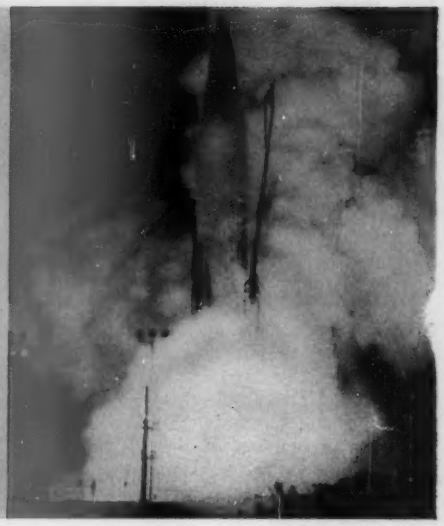
The system used the Whirlwind computer at the Massachusetts Institute of Technology in Cambridge, Mass., because of its availability and general convenience. Flight plan data was made available from the Boston Air Route Traffic Control Center at Logan Airport, covering New England and most of New York state.

Flight plans and progress reports, plus information for other purposes, were transmitted by teletype from the Boston ARTCC directly into the Whirlwind computer, without intermediate tape perforation at either end. The computer automatically acknowledged every incoming message with a reply message over a return circuit. Upon request by the operator the computer also provided detailed page print information on selected flights over the return circuit.

Radar information in the form of range and azimuth target data from two long-range search radars was continuously available to the computer. Both radar and beacon responses were included. This data was converted to a common coordinate system and displayed.

Periodically, the computer would interpolate its stored information to determine the present flight plan position of all aircraft. This information with extrapolated status and computer assigned track number was displayed on four track monitor consoles. Radar informa-

ON EVERY ATLAS COUNTDOWN RMC-LINDSAY PRESSURE GAUGES ARE CONSULTED

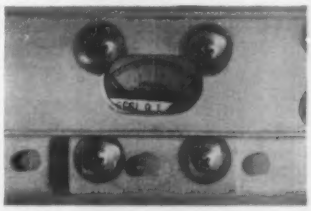


Used for Readout of Gas Pre-Charge in Hydraulic System Accumulators

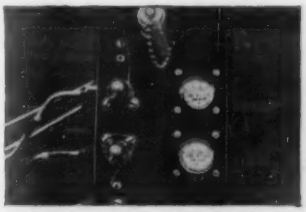
Complete reliability, freedom from jamming even under severe overloads, resistance to shock and vibration, the ability to keep functioning accurately whether setting in the desert sun or subjected to extreme cold . . . these are some of the reasons you will find 6 RMC-Lindsay High Pressure Gauges on each Convair Atlas.

These gauges must withstand shock tests of 100Gs. They are checked for accuracy in vibration tests ranging from 10 to 2,000cps at 35Gs and at ambient temperatures from −65°F to +275°F. *There is no linkage, no gear train to disintegrate or to cause pointer vibration. The indicating pointer is attached directly to the end of the helical bourdon coil.*

RMC Gauges are built to the most exacting laboratory standards for accurate performance under the most rigorous conditions encountered in modern industry, in jet aviation, in astronautics.



RMC Gauge for the booster engine hydraulic system accumulator is flush mounted on the booster engine compartment for easy reading from the outside.



RMC gauges used on sustainer of engine hydraulic system are mounted on the side of the missile fuel tank beneath a maintenance access panel.

If you have a high pressure gauge problem let RMC engineers work with you in its solution. Write, wire or phone:

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RMC
LINDSAY PRESSURE GAUGES

NEW RMC PLANT IN MONROVIA

The new RMC Monrovia, California plant has been specifically designed for full scale plant production of precision instruments without sacrificing laboratory production standards.

tion, periodically redisplayed to form tracks, was superimposed on the flight plan position displays.

The track monitors matched flight plan positions with radar data and, when necessary, updated or corrected the flight plan position using a light gun or switches on the console. The resulting correlated flight plan positions were then prepared by the computer for transmission over a single voice-quality telephone circuit to a remote display.

Independent Processes

Charm did not include an automatic radar tracking feature, such as is used with SAGE. Rather the flight plan extrapolation process and the radar data processing and display were independent. The interaction of the two was accomplished by the track monitors.

One additional feature of the computer program was the automatic checking for possible conflicts of flight plans over fixes, defined as occurring when:

- **Estimated times** over a fix differed by less than 10 min.
- **Altitudes of the two aircraft** differed by less than 2,000 ft.
- **Either aircraft** had not filed a specific altitude but was "on top."

When such a conflict was created, either as a result of filing a flight plan progress report or flight plan revision, the computer printed out the pertinent information as part of the teletype reply to the filed message.

The computer program was constructed to handle only 24 flight plans, enough for the purposes of the experiment. System capacity was set at a limit of 15 fixes per flight plan, and the computer was programed to recognize 225 geographical fixes and 96 different airways.

With the cooperation of the Boston ARTCC, tests of the Charm system using aircraft and radar data were conducted on a twice a week basis from November, 1958, through May, 1959. A planned series of detailed tests was not conducted because of the shutdown of the Whirlwind computer; nevertheless a large amount of experimental data was obtained.

The conclusions were that radar and beacon data could be readily correlated with flight plan data if the latter was accurate and current. Approximately 70% of the attempted correlations were successful. Of the failures, half were traced to faulty or tardy flight plan data while the remainder were unexplained. In general, correlation was excellent during IFR conditions and was less successful during VFR conditions when there was little incentive for the aircraft to adhere closely to the flight plan.

Automatic Tracking Required

A second conclusion was that SAGE-like automatic tracking is required to ease the workload on the monitors and increase their capacity. Without automatic tracking a monitor could handle only three to five flight plans at one time. Also, the closest possible coordination between the controller and the track monitor appears desirable. Ideally, they would not be separated as in Charm but would be located side by side.

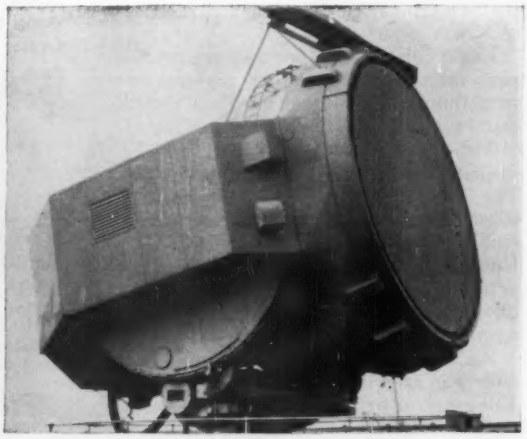
In general, SAGE radar coverage was satisfactory and high blip-scans were observed. Radar coverage was not a cause of lack of correlation.

Computers Cut Workload

High speed digital computers can relieve controllers of the routine- and time-consuming tasks of flight plan and progress report processing, calculation of times over fixes, determination of possible conflicts, and similar processing problems. Of equal, if not greater importance, however, is the application of such computers to the combining and processing of radar, beacon and flight plan data to yield the timely and accurate aircraft position information upon which an improved air traffic control system must be predicated.

High speed data processing techniques and equipments should be applied concurrently to all parts of the air traffic control system. It seems clear that high speed sensing and data acquisition devices such as radars, beacons, and data links will only become effective when they have been coupled to high speed data processing devices. One of the non-technical problems which must be faced is the acceptance of a semi-automatic control system by pilots and controllers accustomed to the present manual system.

Compared with the cost of a separate air traffic control system of similar capability, the integrated system at the super combat centers will represent substantial savings in both money and time. The benefits to the air defense system will be equally important.



HMS Victorious Equipped With 3-D Aircraft Control and Warning Radar

British aircraft carrier HMS Victorious is equipped with new Type 984 three-dimensional aircraft control and warning radar and semi-automatic display system. Unofficial Royal Navy sources say that during the recent North Atlantic Treaty Organization exercise, named "Riptide," the Type 984 system enabled fighter aircraft from the Victorious to complete 90% of their interceptions as opposed to 30% by U. S. Navy carrier aircraft. HMS Victorious is the only carrier to be equipped with the new system at present, but it is scheduled for installation on the remaining British carriers. No information has been made public on the Type 984 system except that it is a complex, semiautomatic electronic system that collects and displays target information which combines early warning with high discrimination of aircraft position in range, azimuth, and height simultaneously. Physical appearance and operating characteristics of the system suggest that the transmitter and receiver are installed within the gyroscopically stabilized antenna housing, with only video signals passed to and from the equipment making up the remainder of the system.

CASE HISTORIES

N/D precision ball bearing end play surpasses needs of linear actuator application. Moreover, bearing is lubricated for extended service against severe climatic condition.

Actuator Photo: Courtesy Armament Division, Universal Match Corp., St. Louis, Mo.

Production Ball Bearings Give Low Cost Answer To B-52 Actuator Problem!

CUSTOMER PROBLEM:

Manufacturer experienced rejects in B-52 aileron trim tab actuator inspections because over-all linear motion could not be held to specified limits.

SOLUTION:

To hold linear actuator end play to proper tolerance, the thrust-supporting ball bearing end play had to be held to a maximum .003". N/D Sales Engineer, working with the manufacturer, recommended New Departure *low cost* single row production ball bearings with standard N/D close internal tolerances. Extensive testing proved that these N/D *production* ball bearings surpassed specifications, assuring end play .001" less than allowed limits. Most important, these high precision N/D ball bearings supplied definite cost advantages over the previous bearings used which required costly hand selection. All this, thanks to New Departure's advanced inspection techniques.

If you're experiencing a bearing problem, or questionable costs in production, why not call on New Departure? There's probably an N/D *production* ball bearing that will meet your specifications, or exceed them . . . and possibly at an over-all cost reduction! For more information write Department G-9.

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The MC-5800 provides FASTER answers

1. Selection of real-time, expanded-time or high-speed compressed-time without reprogramming.

2. Real-time precision @ speeds to 60 solutions/sec.

3. Dynamic memory with time-base accuracy of ±10 μsec provides automatic parameter searching by iteration—an exclusive capability.

4. It programs 134 amplifiers, 30 electronic multipliers, 18 diode function generators, 2 time-delay generators, 8 relay amplifiers, and 6 servos from one 2128-hole patchboard.

5. Unique automatic problem check checks problem-board patching in seconds and can record errors.

6. Exclusive electronic generators of the function of two-or-more variables may be programmed at patchboard in same time required for setup of single-variable generators.

7. Complete control of all amplifiers, multipliers, dividers, and non-linear equipment at patchboard.

8. Quick overload recovery in less than 1 sec.

9. It is the only computer offering card-programmed diode function generators.

The MC-5800 performs MORE ACCURATELY

10. Amplifiers provide lowest noise level output—less than one millivolt at unity gain.

11. Greatest distortion-free amplifier output—30 mils at ± 120 V—only 12 mils quiescent drain.

12. Lowest amplifier grid-current $< 10^{-9}$ ampere.

13. Stable amplifier operation over the entire feedback range from zero to infinity.

14. Drift $< 50 \mu v$ in 8 hours in summing mode.

15. Amplifier frequency response—flat to 10,000 cps and only 3 db down at 28 kc.

16. Only diode function generators utilizing resistors, potentiometers, and diodes of equal quality to those in computing networks.

17. Only diode function generators with individual hi-lo gain positions for *each* segment.

18. Lowest function generator drift < 5 mv/8 hrs.

19. Highest servo multiplier accuracy, ±0.008%.

20. Only fully shielded patch *bay* and patchboard.

21. All contacts in patching system gold-plated.

22. Highest performance electronic multiplier—flat to 10,000 cps and only 3 db down at 20 kc.

23. Only servo multipliers and resolvers with zero backlash gearing—maximum one part in 36,000.

24. DC tachometer feedback on all servos.

25. Dynamic servo error—less than 50 mv at one cps.

26. Lowest step-function overshoot—less than 1%.

27. EVERY SPECIFICATION IS GUARANTEED TO BE TRUE PERFORMANCE STANDARD—IN SUSTAINED OPERATION.

28. Highest sin-cos resolver accuracy ±0.03% peak-to-peak.

29. Power supplies eliminated from console—lowest, most stable operating temperatures—rise $< 3°C$.

30. Passive networks stabilized at $< 1°C$ above room ambient—no oven required.

31. Servo-set pots can be set to 2 parts in 10,000.

32. Accuracy of computing networks at least 0.01%.

33. Lowest computer cross-talk—rejection greater than 2,000 to 1.

The MC-5800 can be operated at LESS COST

34. Greatest available problem capacity per dollar—by 20%.

35. Least cost for future expansion.

36. Output tube filaments operate with DC bias for maximum life.

37. Centralized overload indication for quicker trouble-shooting.

38. Only computer with hermetically sealed transformers.

39. Choppers employ double-contacts in parallel for maximum life.

40. Plug-in relays and step switches throughout for least down time.

41. Plug-in dynamic components ease maintenance.

42. Quickest trouble-shooting by automatic problem check.

43. Costliest and best patching system for lowest programming cost thru maximum reliability of patchcord connections.

44. Choppers de-energized when computer in standby for max. life.

45. Separate power-supply venting minimizes room heat load.

46. Exclusive equipment-door packaging for free access and quick maintenance *without* shutdown.

47. Insulated patchboard prevents costly shorting accidents.

48. Sealed servo gear boxes for maximum reliability.

49. Fully transistorized ADRAC system with plug-in logic modules.

50. Available on lease basis as well as for purchase.

The MC-5800 can SOLVE MORE OF YOUR PROBLEMS

51. Exclusive dynamic memory makes automatic iterative solution of statistical or optimization problems a reality.

52. Dynamic memory + high-speed quick-reset rep-op provide practical approach to solution of simultaneous partial differential equations.

53. Exclusive bi-variable function generators can also be used as amplifiers, multipliers, or generators of single-variable functions.

54. More computer capacity per dollar means more solutions.

55. Solution of problems with up to 15 amplifiers in closed loops.

56. Starting with as few as ten amplifiers, at a cost of little more than the cheapest available computer, you can build to a complete computing center of unsurpassed performance.

57. Add-on capacity up to 134 amplifiers, 30 electronic multipliers, 18 diode function generators, 2 time-delay generators, 8 relays with amplifiers, 4 bi-variable function generators, 6 servos, 8 function switches—all field-expandable without mechanical rework or rewiring.

58. Add-on features include automatic problem check, integrator rate test, high-speed repetitive operation, dynamic memory, expanded-time base, compressed-time base, servo-set potentiometers, and ADRAC (Automatic Digital Recording and Control) system—all field expandable without mechanical rework or rewiring.

There are over 100 more facts—let us tell you about them in person, or better still, visit our factory—and see for yourself!

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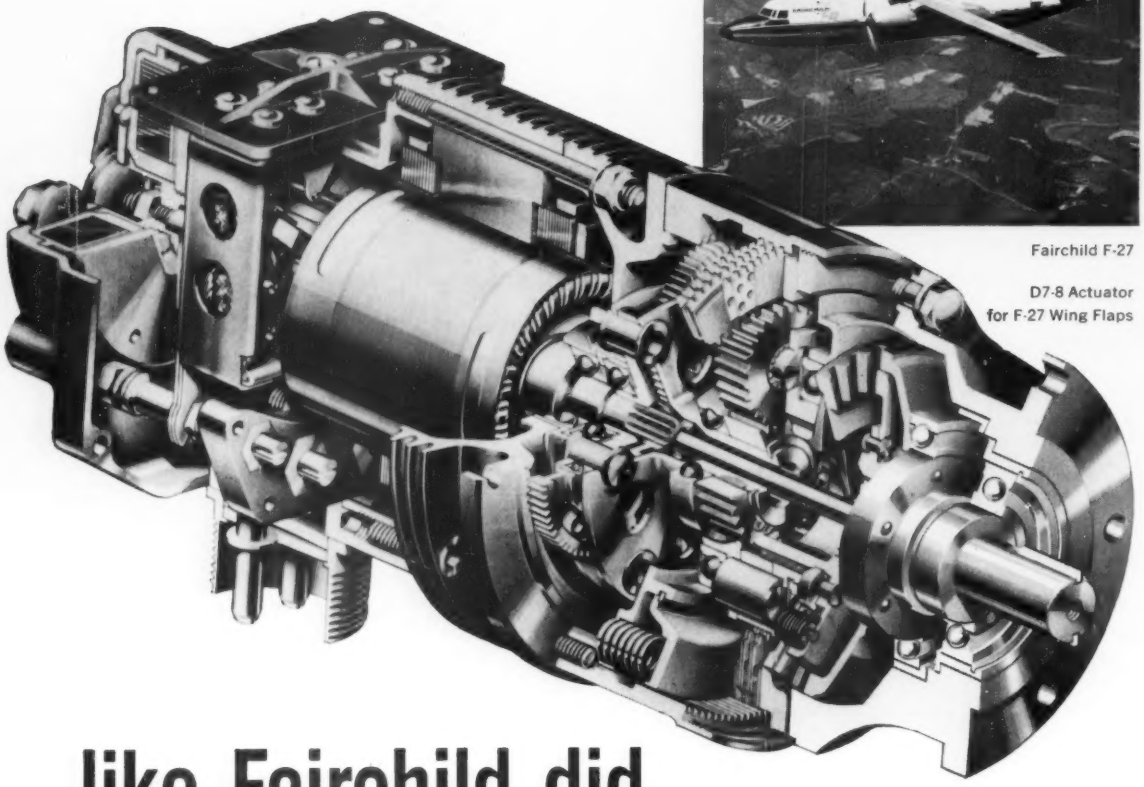
ACTUATE...

Fairchild F-27



D7-8 Actuator
for F-27 Wing Flaps

...like Fairchild did with its F-27

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NEW RADIATION TRACKING TRANSDUCER, consisting of simple semiconductor cell without any moving parts (left), can be used to determine direction to any object which radiates visible or infrared radiation when used with simple lens system (right). New transducer, developed by Electro-Optical Systems, Inc., appears attractive for missile and space vehicle guidance or stabilization. Device also can be used as an accurate optical pick-off for precision gyros and accelerometers.

Detector Tracks Infrared Radiation

By Philip J. Klass

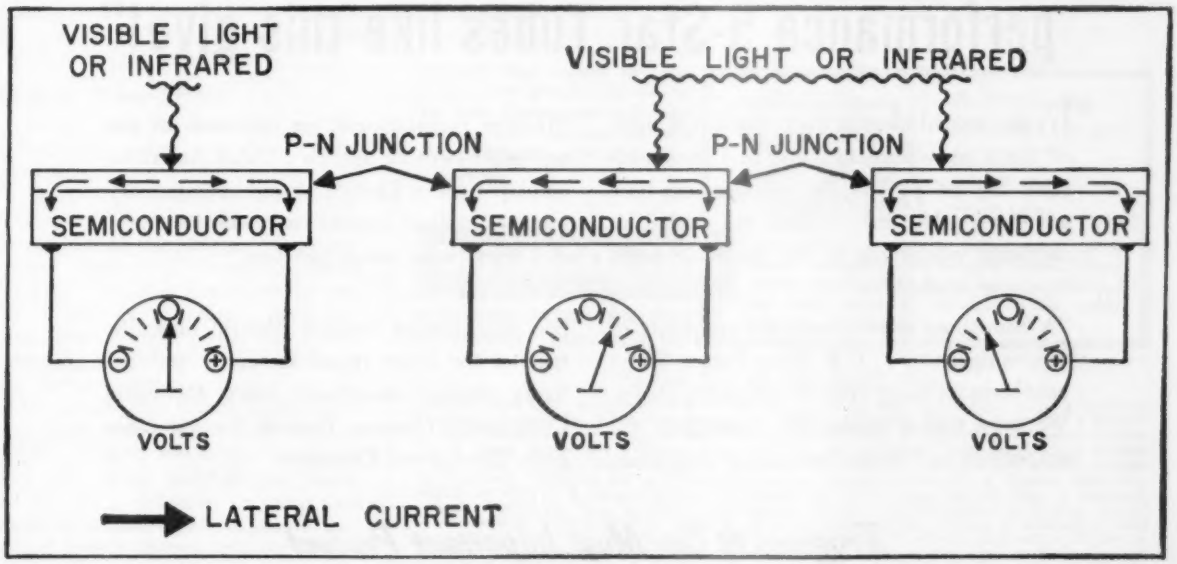
Pasadena, Calif.—New semiconductor device that can detect and electrically track any object that emits visible or infrared radiation offers attractive possibilities for missile and space vehicle guidance and stabilization.

The novel device, developed here by Electro-Optical Systems, Inc., is called a radiation tracking transducer. The transducer, which has no moving parts, also can be used as an extremely sensitive optical pick-off which imposes no load or burden on gyros and accelerometers.

Development is sponsored by the Army Ballistic Missile Agency.

The transducer is a photo-voltaic unit that can resolve the angular position of a source of visible or infrared radiation along a single axis or two mutually perpendicular axes. The output is a d.c. voltage whose polarity indicates whether the radiation source is to the right or left of the cell's centerline and whose magnitude is proportional to radiation source displacement from centerline.

The new transducer can resolve the



PRINCIPLE OF OPERATION of new radiation tracking transducer is illustrated above. When light or infrared strikes center of the cell, equal and opposite lateral currents flow, producing zero voltage across output terminals. When cell is illuminated either side of center, magnitude of output voltage is proportional to displacement from center and polarity of output signal indicates side.

PAN AM

First with commercial trans-ocean jet service using U.S.-built planes, Pan American has halved flying time between world capitals and other major cities. The 600-mph-and-up speed at which Boeing 707 jets fly, accents the need for top reliability of air-navigation, radio, other electronic equipment . . . and all tubes and components.

Says: G. F. SHEPHERD, Foreman—Component Overhaul, Pan American World Airways System:

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"They're manufactured for the needs of the new super-swift air age. So . . . Pan American employs General Electric 5-Star high-reliability tubes in critical sockets, to make jet travel still safer, surer, more punctual."

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ELECTRO-OPTICAL SYSTEMS, Inc. is now producing pilot quantities of the new radiation tracking transducer in Pasadena.

angular position of a radiation source to better than 0.1 sec. of arc, according to Dr. A. M. Zarem, company president. Presently available transducers made of silicon are sensitive over wavelength of 0.5 to 1.1 microns, while germanium units are sensitive out to about 1.7 microns. Using indium antimonide as the semiconductor material, the company believes it can develop a cell which is sensitive out to seven microns in the infrared region, according to Dr. David Wright, manager of the firm's Solid State Division.

The transducer itself is small, relatively simple in construction. Optimum size appears to be about one inch in diameter for the sensitive surface, although units as large as two inches and as small as 0.02 in. have been fabricated, according to Wright.

Lateral Photo-Effect

Wright says the radiation tracking transducer operates on the lateral photo-effect, first reported in 1957 by Dr. J. T. Wallmark of Radio Corp. of America. Wallmark discovered that, in addition to the primary voltage produced across a P-N semiconductor junction when it is illuminated by visible or infrared radiation, small currents flow laterally along the P-type material, circulating around through the N-type material.

To utilize this lateral photo-effect, tiny ohmic contacts are made only to the P-type layer which are located at each end of the material (see sketch p. 79). If a voltmeter is connected across these two terminals and a tiny spot of light is directed onto the N-type layer at a point midway between the two terminals, the lateral currents will travel equal distances, producing equal

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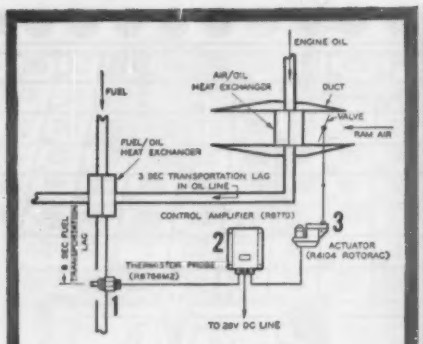

AIRBORNE R8010 TEMP. CONTROL SYSTEM

Schematic diagram of temperature control system developed by Airborne for use on Martin P6M2 Seamaster. System operates on 28 v d-c, maintains fuel temperature at approximately 200°F. by monitoring ram air flow to air/engine-oil heat exchanger. Oil is used in turn to heat fuel.

Airborne electromechanical system regulates jet fuel temperature

An integral part of each main engine installation on the Martin P6M2 Seamaster is an Airborne R-8010 custom-engineered temperature control system. By regulating air flow through a heat exchanger, this system maintains supply line fuel at 180-220°F.

As developed for the P6M2, the R-8010 system consists of a thermistor probe, a control amplifier and a rotary actuator. The probe (mounted in an MS10057-12 fitting) is in direct contact with the temperature-regulated fuel and presents to the control box a resistance which is proportional to fuel temperature. In response, the control box energizes the actuator to change the setting of a ram air intake valve, thus regulating volume of air flow through an air/fuel heat exchanger. This sensing and response continues until prescribed fuel temperature is attained, at which point the system reaches a state of electrical balance.

A fail-safe feature is also provided. In the event of power failure, a magnetic clutch in the actuator is released, permitting the air valve to be pushed open by the force of the ram air.

This application* on the P6M2 illustrates only one of many possible adaptations of the Airborne R-8010 system for temperature control functions on aircraft, missiles and related equipment—cabin temperature control, engine temperature control, temperature regulation of fuel, oil, electronic cooling packages, etc. If you have requirements in these areas, we will be happy to make a proposal. Contact any of our offices.

*Described in detail in new Bulletin PS-4A, available on request.

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voltage drops. Under this situation voltage across terminals will be zero.

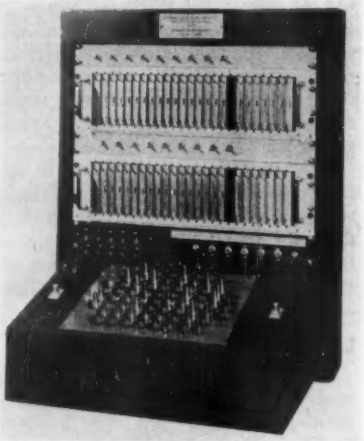
However, if the spot of light is shifted toward one of the terminals, the lateral current path in this direction will be decreased, reducing the voltage drop, while the current path and voltage drop to the other terminal is increased. This will result in a net voltage of one polarity appearing across the two terminals. If the spot of light is moved in the opposite direction, the situation is reversed, and the voltage appearing across the terminals has the opposite polarity.

The further the spot of light is shifted from center, the larger will be the voltage appearing across the terminals.

Two-Axis Tracking

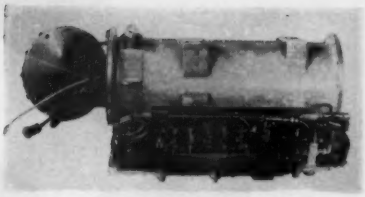
For two-axis tracking, the transducer is constructed in the shape of a circle with output terminals located at 90 deg. intervals around the periphery. The output from one pair of terminals (180 deg. apart) indicates light source position along that axis, while the output from the other set of terminals indicates position along a perpendicular axis.

Thus, the two transducer output



Circuit Reliability Tester

Circuit design reliability tester can be used to determine how new circuit will perform under all possible variations in basic circuit component values. Circuit to be tested is constructed on horizontal patch board using two sets of components, representing extreme upper value and the extreme lower value likely to be encountered due to manufacturing tolerances or changing environmental conditions. Tester then uses speedy digital switching techniques to check circuit operation with every possible combination and permutation of circuit components. Type 90 tester shown, developed by Airborne Instruments Laboratory, Huntington Station, N. Y., can check circuits up to 16 components. Price is $2,950.



Parametric Amplifier

Parametric amplifier, shown removed from its external housing, provides a noise figure of 1.9 to 2.9 db. at a center frequency of 960 mc., with a tuning range of plus 75 mc. Developed by Airborne Instruments Laboratory, Huntington Station, N. Y., the low-noise RF receiver has a reactive stage gain of 18 db., a bandwidth of 20 mc., an intermediate frequency output of 30 mc. Amplifier is priced at $9,850.

voltages, by their magnitudes and polarities, define the position of a radiation emitting source about two axes for use in scanning or tracking.

Detector Characteristics

Here are typical performance figures which have been achieved on radiation tracking transducers produced to date:

- **Maximum output voltage:** 42 millivolts per milliwatt of light beam power across a 20,000 ohm load.
- **Linear sensitivity:** 0.32 millivolts per milli-inch per milliwatt of light beam power.
- **Angular sensitivity:** 16 microvolts per sec. of arc per milliwatt of light beam power based on a focal length of 10 in.
- **Minimum detectable power** (assuming resolution of one microvolt): 0.015 microwatts.
- **Time constant:** Five microseconds.
- **Internal impedance:** 3,000 ohms.

Experimental transducers have been fabricated with greater sensitivities and output voltages, Wright says, but the above figures are representative of current production units.

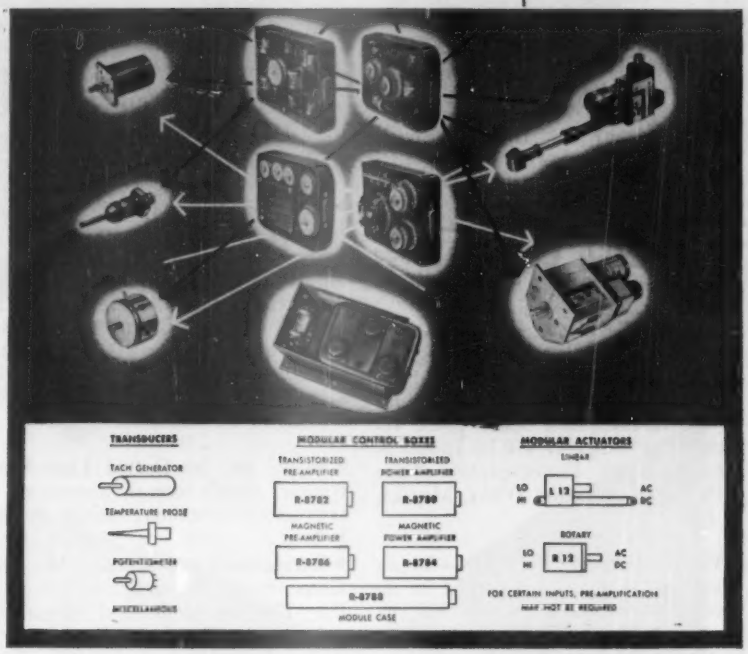
Linear Response

The linearity of the device depends upon its size and on how much of the working surface must be used. For null-seeking applications, of course, linearity is not a consideration. If extreme linearity is required over a rather large working surface, additional terminals can be fabricated around the periphery of the device and connected to an external feedback network, according to Wright.

Experimental samples can be fabricated to meet individual customer requirements, with prices running under $100 per unit. In production, cost of the transducer is expected to be under $50, depending upon required linearity. Electro-Optical Systems' address is: 170 North Daisy Ave., Pasadena, Calif.

Now—Modular Control Systems

New Airborne concept saves design time, helps you get faster delivery



Heart of Airborne's new modular control systems is a contactorless control package consisting of a standardized case (3 x 3½ x 5 in.) into which packaged preamplifier and power amplifier subsystems are plugged. Amplifiers drive actuators having maximum operating loads up to 500 lb. (linear) or 100 in.-lb. (rotary). Modular design permits delivery of relatively complex systems in minimum time.

Over the past 6 years, Airborne has designed and produced a number of special electromechanical control systems for aircraft-missile use. While these have differed in their functions, many of them have nevertheless employed essentially similar components. Thus our policy has been to seek increasing standardization of parts through modular design—to the point where we can now offer complete systems engineered under this concept.

From transducer through actuator, these new Airborne systems are assembled entirely from standardized, interchangeable components. For many applications, you can design around these packaged systems as they stand—and thus reduce engineering time, lead time, and costs. In other instances, slight modifications of the modular units provide the basis for immediately available systems.

Get complete information on this latest Airborne development by requesting new Bulletin PS-5A. If you feel your requirements are unique and cannot be met with standardized units—however flexible—we still invite your inquiry. As mentioned, Airborne offers an extensive background in custom systems—for temperature control, servo control, and positioning.

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Yugoslavia Purchases British ILS Systems

London—Three Pye instrument landing systems will be delivered to Yugoslavia by Pye Telecommunications, Ltd., Cambridge, England, at a cost reportedly in excess of $245,000. The Pye ILS delivered will include VHF and HF air-ground radio equipment, a fixed station and mobile radio-telephones for airfield vehicle control. The same system was purchased by Aeroflot recently (AW June 1, p. 52) for installation at Moscow airport. Pye ILS is an initial approach aid used with British blind landing system.

FILTER CENTER

▶ **Libra-Track for Centaur**—Modified version of the Libra-scope AN/ASN-24 transistorized digital computer has been selected for use as a guidance computer in the Atlas-Centaur space probe vehicle. The computer will be known as the Libra-Track. For description of the ASN-24, see AVIATION WEEK, May 25, p. 124.

▶ **Video Recorder for ECM**—Ampex video tape recorder, widely used for recording television programs, will be used for airborne electromagnetic radiation reconnaissance because of its extreme wideband recording capability.

▶ **Mechanized Transistor Production**—Watch for a major West Coast semiconductor manufacturer to unveil new mechanized assembly facilities capable of turning out 18,000 transistors per hour on 10 mechanized lines. At this peak rate, company could produce 36 million units per year on an eight-hour shift.

▶ **Lightweight Inertial Navigator**—All-inertial navigator which Litton Industries will produce for use on F-104G to be purchased by West German air force is expected to weigh only 75 lb., including computer and stabilized platform. Volume will be about 2 cu. ft. Total system error is expected to be less than 1½ mph.

▶ **Novel Recruiting Twists**—Republic Aviation tried a novel approach to recruiting engineers at recent Western Electronic Convention. Attractive Chinese girls, in native garb, circulated around the Cow Palace handing out Chinese fortune cookies. Upon breaking into the cookies, engineers found the usual tiny slips of paper but with an unusual message: "A brighter future can be yours at Republic Aviation. Call George Hickman GA-1-0980." Another version read: "Republic Aviation may have the job you want. Make good fortune. Call George Hickman."

▶ **Lightweight Radar Altimeter**—Radar altimeter which weighs only 10 lb. and which reportedly is accurate to within one foot near the runway, to within 2% at 2,000 ft., has been developed by Bendix-Pacific as part of the Army-Navy Instrumentation Program (ANIP). New altimeter will be used with lightweight airborne radar developed by Bendix-Pacific for helicopter navigation, approach and landing under instrument weather conditions.

▶ **Atlas-Minuteman Batteries**—Automatically and manually activated silver zinc batteries for Convair's Atlas ICBM and automatically activated batteries for Minuteman ICBM control systems being developed by Autonetics Division of NAA will be produced by Cook Batteries, subsidiary of Telecomputing Corp. Convair contract is for $295,000; Autonetics for $120,926.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **International Business Machines Corp.** reports contract from AC Spark Plug Division of General Motors for airborne digital computer to be used in inertial guidance system for Titan ballistic missile. AC Spark Plug will build gyro stabilized platform.

• **General Electric**, Heavy Military Electronics Department, Syracuse, N. Y., $22 million contract from Rome Air Materiel Area for production of radar course directing groups for detecting and tracking air targets as part of the Badge air defense system (212-L) for protecting overseas air bases.

• **Telecomputing Corp.**, Los Angeles, $415,926 contract for batteries to be used in Atlas and Minuteman ballistic missiles. Work will be performed by Cook Batteries subsidiary in Denver.

• **Nuclear Electronics Corp.**, Philadelphia, reports four Navy contracts totaling $1.2 million for test equipment. Largest, from Aviation Supply Office, is for high frequency signal generators.

• **Ferranti-Packard Electric, Ltd.**, Toronto, has received $1.5 million contract from Trans-Canada Air Lines for binary computer center to be used with the airline's new electronic reservations system.

• **Ryan Aeronautical Co.** received a $1,920,000 Navy contract for additional spares and support equipment for APN-122(V) doppler radar navigator equipment being produced for Navy aircraft under an initial $20 million contract (AW Nov. 10, 1958, p. 101).

PILOT PERFORMANCE
A SPECIALTY AT VOUGHT

Ten miles high, at 1,000-plus mph, pilots will fly "in their shirt sleeves."

A protective capsule will take over the job of providing environmental protection of the flier. No longer will he need to encumber himself with oxygen mask, pressure suit, personal parachute, bail-out oxygen bottle, life jacket and raft and other survival gear. Sealed off in his protecting "thermos bottle," the pilot also is provided a highly advanced emergency escape method: the entire capsule can be detached from the airframe and gently parachuted to the ground.

Chance Vought conceived this system and now is developing it under contract. The advanced capsule is typical of the human factors progress Vought stands for.

This company has won its reputation largely through its own aircraft. As speeds vaulted above 1,500 mph, Vought learned to design cockpits of very high density. Meeting stringent carrier requirements in the design of *Crusader* series fighters, company engineers developed an exceptional feel for balancing high and low speeds in a single vehicle.

This experience is ideally suited for human factors work in spacecraft, as Vought has already proved in specific applications on projects under contract.

Today, in a space-oriented Cockpit Laboratory, Vought is working out the details of pilot seating, instrument displays and manual controls to make man not only a passenger, *but an operator,* of spacecraft.

Piloted aircraft, along with atmospheric missiles and antisubmarine warfare, are specialties in Chance Vought's Aeronautics Division. Other major interests are being aggressively advanced in the company's Astronautics, Electronics, Research, and Range Systems Divisions.

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CHANCE VOUGHT
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Newest Lear plant, Grand Rapids, Michigan, open September 25, 1959

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This unusual, most advanced facility will produce vital precision guidance and control products for aircraft, helicopters, missiles, anti-missiles and space vehicles.

Lear

CARGO-CARRYING ground cushion vehicles of several sizes similar to the two in the artist's conception on the right can be built from basic 8-x-16-ft. sections. The concept of these low-pressure ground-cushion vehicles has been developed by Spacetronics, Inc. Detail design of the vehicles and their 8-x-16 ft. modules has been made by the Aluminum Corp. of America. Center section of the smaller Marine Corps vehicle (see artist's sketch below) is under construction by Spacetronics at left. Single lifting propeller (left, foreground) for the vehicle pumps a large volume of very low pressure air.

Air Cushion Vehicle Designed for Marines

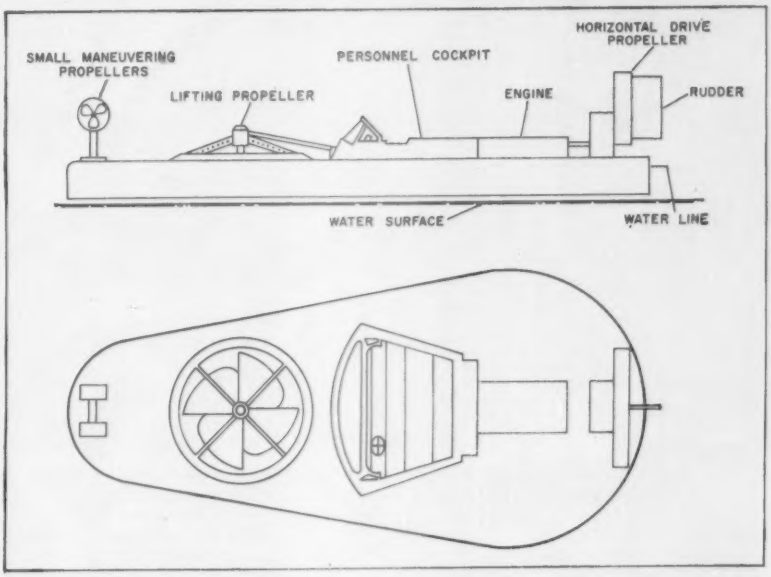
Washington—First military contract for the purchase of a plenum chamber ground cushion machine has been awarded by the Marine Corps to Spacetronics, Inc., of Washington, a small pioneer firm in this field.

The 30-x-24 ft. long vehicle can carry eight men approximately 100 mph. and is powered by a single 270 hp. gasoline-fueled industrial engine.

Commercial Application

First commercial application of the plenum chamber vehicle also is in an advanced state of planning by Spacetronics for Southern Airways, Inc., of Miami, which has agreed to buy two large units for cargo service to the Bahama Islands if they meet the estimated performance. Spacetronics estimates that the vehicle, a 50-x-32 ft. barge-like machine that weighs 15,000 lb. empty, can carry a 40,000 lb. payload. Cruise speed of the vehicle, which will be powered by five 270 hp. industrial engines, is estimated at more than 50 mph. over smooth water. The company believes top speed of the vehicle will approach 100 mph.

Detail design of these cargo vehicles already has been completed by the engineering department of the Aluminum



ARTIST'S DRAWING of Marine Corps vehicle shows its general layout. Main unit is 30-x-8-ft. rectangular center section that will carry engine and all heavy loads. It is filled with Styrofoam for buoyancy. Two sets of wings will be provided, one with a maximum width of eight feet per side; the other four feet. A plenum chamber approximately two feet deep is formed under the vehicle by adding a skirt around the bottom. Use as a sport vehicle has been considered, in addition to military and commercial service over water, swamps, ice fields and mud, carrying relatively large payloads.

SOLID PIECES of Styrofoam are cut for the center section of the Marine Corps vehicle. Liquid Styrofoam is then poured in to completely fill and bond the sections.

Corp. of America. ALCOA, through its policy of aiding young firms that show promise of increasing the market for aluminum, has made both construction materials and the assistance of its engineering department available to Spacetronics without cost.

Actual construction of the large cargo vehicle will begin in October. The Marine Corps vehicle will be delivered before Jan. 11 under the terms of the contract. Spacetronics will build two of these units, keeping one for experimentation and demonstration of handling characteristics to prospective buyers. First of these is in an advanced state of assembly and is scheduled to "fly" for the first time sometime within the next two months. The plenum chamber idea as has been advanced by Spacetronics has one basic feature which apparently differs considerably from the many ground cushion ideas under experimentation by a number of firms and private individuals in the U. S. as well as abroad.

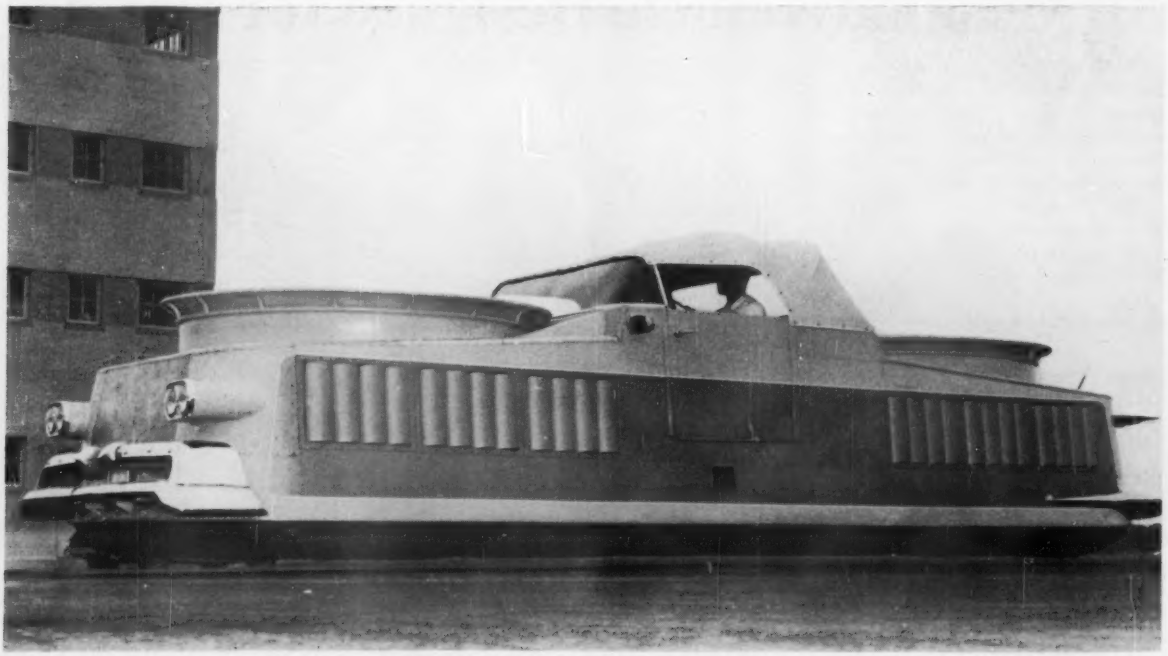
Low Pressure System

This concept is to use very low pressure air to support the vehicle. The average pressure in cruise for the small-scale vehicles—some of which have been large enough to carry a man—that have been built by Spacetronics thus far is around 2 oz. per sq. in., or about 18 lb. per sq. ft.

Most other experimenters are using considerably higher air pressures and elaborate systems of internal ducting to distribute the air evenly under the vehicle.

There is no internal ducting required on the Spacetronics vehicles which essentially resemble overturned pie plates.

It has previously been shown experimentally that the propeller used to pump air under the vehicle may be considerably off center, and the vehicle will remain level and stable if large amounts of air are moved at slow speeds. The low pressure air will distribute itself properly under the vehicle without ducts or guide vanes of any type. The vehicle to be delivered to the Marines will use



Curtiss-Wright Tests Second Prototype Air-Car

Prototype of Curtiss-Wright Model 2500 Air-Car (AW July 6, p. 115) will be manufactured at the South Bend Division of Curtiss-Wright Corp. beginning in November. Vehicle is designed to carry four passengers over unobstructed terrain at a height of 6-12 in. Suspension is accomplished by ducting air into a plenum chamber and maintaining approximately $\frac{1}{10}$ lb. psi. pressure underneath the vehicle. Length of the Air-Car is 28 ft.; width is 8 ft. Curtiss-Wright is also developing prototypes of an Air-Bus and Air-Truck.

MOTOROLA MILITARY ELECTRONICS CAPABILITIES REPORT:

Strategic Deployment of Technical Personnel

Dr. Daniel E. Noble, Executive Vice President, Motorola, Inc.

"Dynamic organization...not static...is the key to productive use of technical talent in the field of military electronics."

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William S. Wheeler, Vice President and General Manager
Military Electronics Division

Arthur Reese, Vice President and General Manager
Communications Division

Three field commanders direct day-to-day activities of Motorola's technical divisions. Wheeler's Military Electronics Division concentrates directly on military problems, drawing on the resources of Reese's Communications Division (world's largest producer of two-way communication systems) and Hogan's Semiconductor Division (world's largest producer of power transistors and leader in mesa transistor development and production). Behind this technical task force stands Motorola's strength in consumer electronics; in an emergency the company's total complex of 18 plants in four states can be converted to mass production of military equipment.

Dr. Lester Hogan, Manager
Semiconductor Products Division

Of Motorola's 2,000 engineers and scientists, four out of five work under the direction of Dr. Daniel E. Noble, Executive Vice President. One of the three divisions under his command is devoted exclusively to military electronics; two others provide strong support. Working together, they form a

MOBILE TECHNICAL TASK FORCE

Officials of the Air Force Flight Test Center at Edwards faced a particularly knotty problem. Specialized microwave equipment was required to relay telemetry from aircraft in remote areas.

At the request of the military, Motorola rapidly assembled the talent and equipment of its tri-divisional technical task force. Heaviest contributions to the project were made by Motorola's Military Electronics Division. But important help came from other sources: microwave equipment and vhf receivers from Motorola's Communications Division; specialized transistor circuitry from the Semiconductor Products Division.

With this swift concentration of technical talent drawn from a diversity of company sources, Motorola was able to solve a major problem for the Air Force in record time.

Few organizations serving the military today can so rapidly merge diverse technical talents and productive capacities as can Motorola. Its three "task force" divisions, under the single command of Dr. Daniel Noble, can be marshalled almost overnight for the solution of urgent military electronics problems. Cross-fertilization of ideas and techniques is the certain result.

The success of this flexible organizational structure was again demonstrated by Motorola's part in the development of the Project Mercury Space Capsule. The Capsule's command control receiver, developed by Motorola's Military Electronics Division, is the smallest all-transistorized radio receiver of its type available, thanks to mesa transistors developed by the Semiconductor Division and miniaturization techniques borrowed from packaging specialists of the Communications Division. In another instance, Motorola's Semiconductor Division developed the first samples of a new type of electronic facsimile paper with important military applications.

In an era marked by a chronic shortage of competent brain-power, Motorola's strategic deployment of its technical resources is an effective answer, both in the solution of current problems and in conducting long-range research.

Strategic deployment of manpower is only one of the reasons why Motorola is able to design, develop and produce military systems and equipment with speed, economy and reliability. Motorola's exclusive concentration in electronics, its cost-conscious approach to producibility, and its preoccupation with reliability, are evident in every Motorola military product, from the smallest solid state device to the most complex weapons systems.

For a comprehensive brochure on Motorola's Military Electronics capabilities, write: *Technical Data Service, Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Scottsdale, Arizona.*

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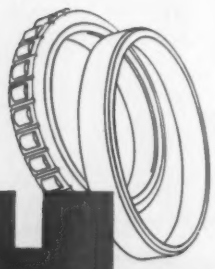


HYATT HY-ROLL BEARINGS have first call in the specifications for today's most advanced aircraft power plants. Across the entire speed range, HYATT bearings always deliver precision dependability. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

Another GM GENERAL MOTORS contribution to aviation progress

HYATT HY-ROLL BEARINGS FOR AIRCRAFT INDUSTRY

an off-center pumping unit and no vanes or ducts.

One of the most desirable features of the Spacetronics machines that has been demonstrated by experiment is the almost complete absence of dust and spray as they pass over land and water. Dust and spray clouds that are easily spotted and have detrimental effects on the crew and their equipment have been one of the major complaints regarding the possible military use of high pressure ground cushion machines. Cost of the Marine Corps vehicle is $26,000. Spacetronics estimates the price of its large cargo units at $60,000.

2-3-ft. Altitude

Most of the Spacetronics designs will stabilize two or three feet from the ground above a smooth surface at the pressure level of about 18 lb. per sq. ft. To go over obstacles, rough ground or choppy water, it has been possible to increase the distance from the ground by two or three feet more by going to about 40 lb. per sq. ft. pressure. This is believed to be about the maximum with the propellers now used. It is believed, however, that the use of long flexible skirts are practical on these low pressure vehicles to allow large units to go over obstacles more than 10 ft. high.

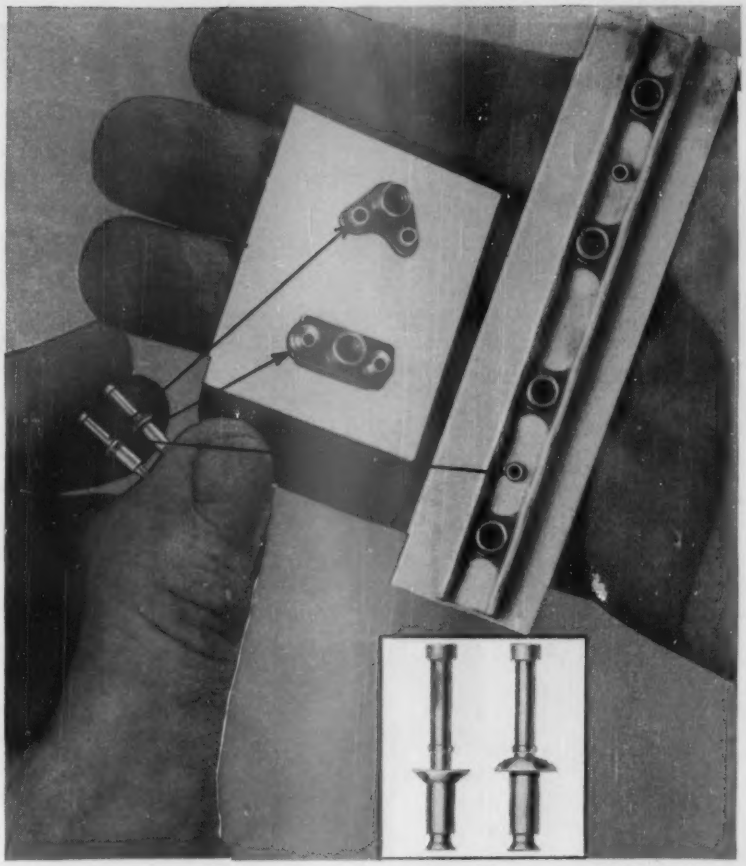
The Spacetronics vehicles are based upon work performed several years ago by Walter A. Crowley, a chemist who is now with the company. A number of improvements were later made by company engineers headed by Carl W. Bollum, Sr., president of Spacetronics. These have improved the lifting power and stability of the more recent vehicles.

ALCOA Design Effort

The large cargo vehicle that is scheduled to go into production in three months has had a great deal of flexibility designed into it by the ALCOA engineers. Basic construction sections are 8 x 16 ft. made of sheet aluminum reinforced with standard extrusions. To provide buoyancy, they are filled with Styrofoam. Only one new type of extrusion was required and it already has been prepared by ALCOA. This extrusion will allow the sections to be floated and then joined from the top without requiring a worker to crawl beneath the vehicle.

Many different vehicles can be formed by joining these basic construction sections to fan sections and then fastening the 8-ft.-long skirt sections around the perimeter to form the plenum chamber.

The stability of a large rectangular vehicle with a fan section on each corner has been found to be unaffected if one of the fans should go out. Height of the vehicle also does not change



For those "impossible" installations

Cherry Research Offers The 3/32" MONEL Hollow Pull-Thru Rivet

Available with either universal or 100° countersunk head, the Cherry 3/32" Monel Hollow Pull-Thru Rivet has a high shear strength particularly adapted to fastening nut plates, gang channel and honeycomb materials where extremely limited space makes use of solid rivets difficult. Damage to surrounding material in these difficult spots is eliminated with the pull-thru hollow rivet. Simplicity and speed of installation cut costs and save weight.

The new 3/32" Monel Hollow Pull-Thru Cherry Rivet can be installed with all existing Cherry Rivet guns, including the G-25 Hand Gun.

For technical information write to Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, Calif.

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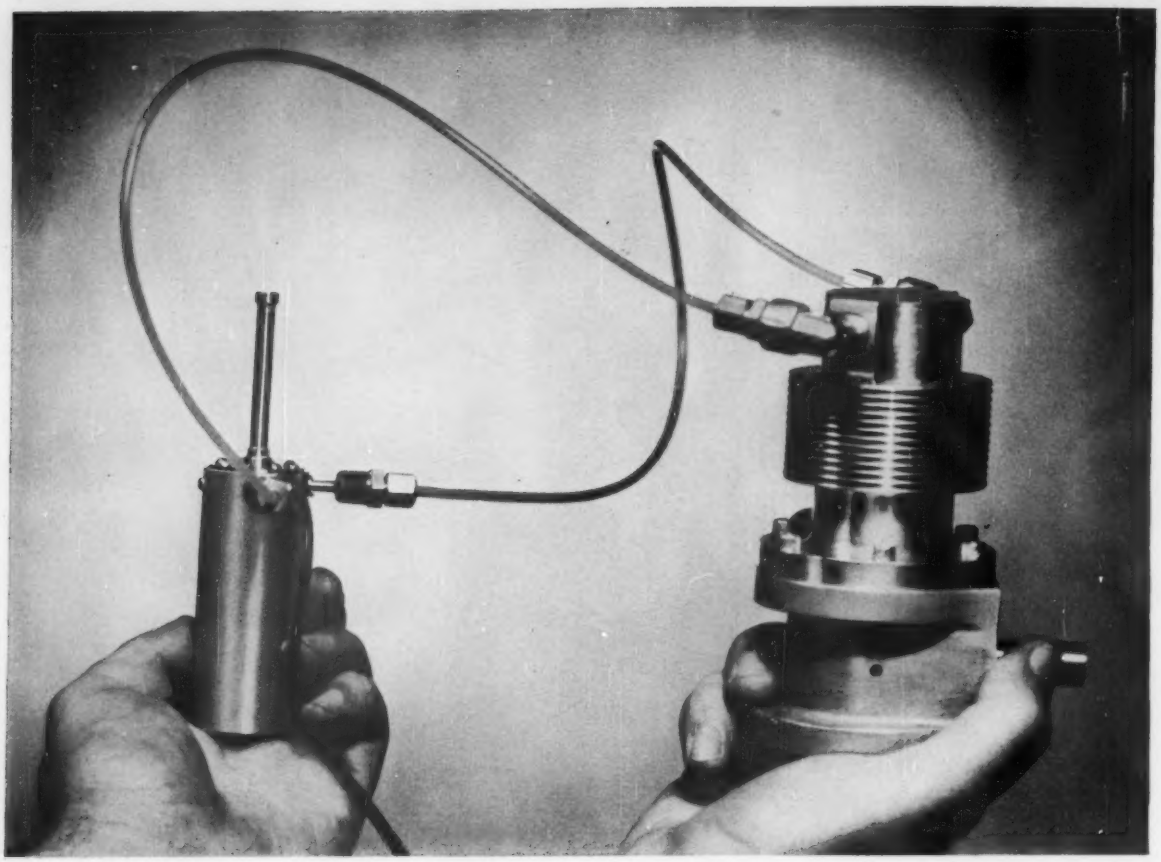

Tiny super-coolers from Hamilton Standard

FOR INFRARED APPLICATIONS

This is a closed cycle, low-pressure mechanical refrigerating system that can chill infrared cells to any predetermined temperature down to 60 degrees Kelvin (-350°F). Such extremely low temperatures increase the sensitivity of infrared detectors, giving them extended long wave length response.

The system, one of many possible package configurations, comprises the min-IR-cooler, at left, with a new miniaturized compressor. The combination provides the first reliable miniature system yet devised that will produce such low temperatures. Weighing under 10 pounds complete, it is ideal for operation in missiles or aircraft. It is further adaptable to any IR application and to a wide range of environmental conditions.

The min-IR-cooler was conceived by Arthur D. Little, Inc., and jointly developed with Hamilton Standard to perform with a Hamilton Standard-developed compressor offering high performance at unusually low weight. The system is an important new addition to the complete range of temperature and environmental control devices and systems produced by Hamilton Standard.

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by a large percentage in this condition.

In addition to the military and commercial application of vehicles that can rapidly cross water, swamps, ice fields and mud, with large payloads, an interest has been expressed for sport machines of this type. Business interests in Miami, who believe that a large market would exist for a similar vehicle that could carry six or eight people and sell for $3,500 to $4,000, already have approached Spacetronics.

Soviet Pilots Urged To Limit Drinking

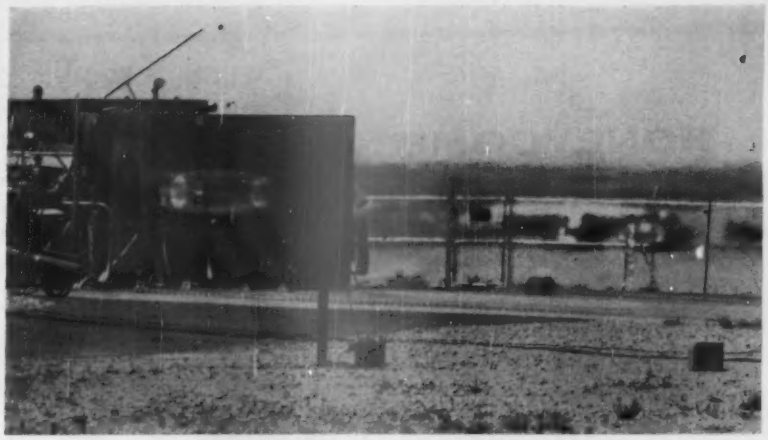
Moscow—Red Air Force has begun official warnings to pilots to avoid alcohol and to follow stricter regimes during their off-duty hours.

Two Russian aviation medicine specialists—Lt. Col. B. Zak and Maj. L. Bondarenko—have published a warning to pilots and have emphasized a regime of physical training and psychological training for off-flying hours in Sovetskaya Aviatsiya, official Red Air Force newspaper.

Western observers of the Russian scene have long been aware that alcoholism is a major social problem among the rank and file, as well as in high places. But this is the first time that an official stand has been taken on the subject for military pilots. It may herald a crackdown in the Russian units.

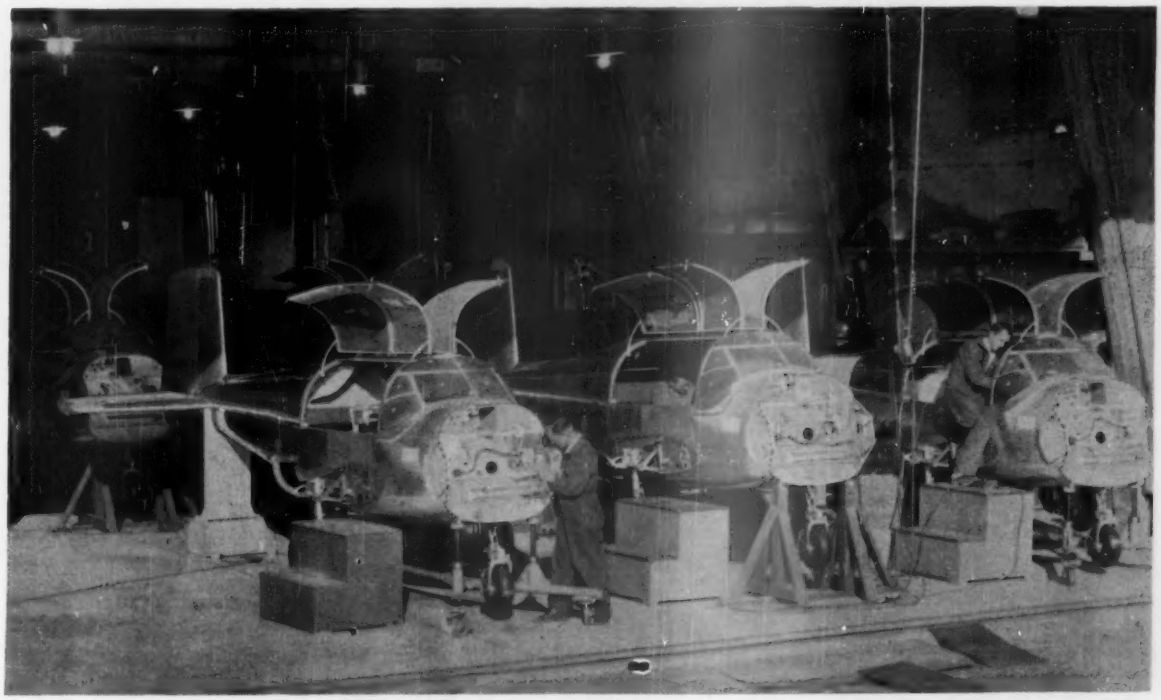
Zak and Bondarenko warn that air crews are being disqualified from flight because of their lack of attention to the simple facts of physical care. The doctors point out that flying is not at all harmful, that in fact it increases the officer's capacity for work, and that over the years, that desirable quality is not lost at all.

As an example they point to military



X-15 Rocket Engine Tested

Exhaust blast issues from the nozzle of Reaction Motors XLR-99-RM-1 rocket engine during first test firing at Edwards Air Force Base, Calif., earlier this month (AW Sept. 14, p. 67). Shimmering heat waves distorting fence and background (right) indicate a 40- to 50-ft sheet of flame emitting from engine. Liquid oxygen and liquid ammonia fuel is consumed at a rate of about 10,000 lb. per min. Exhaust temperature is about 4,000F. First test was run at three-fourths throttle for 46 sec. The 50,000-lb.-thrust engine will power the North American X-15 following extended tests at the flight test center.



Saab Produces Five Safirs per Month

Saab 91D Safir production line at Linkoping, Sweden, plant at Svenska Aeroplan Aktiebolaget. The fully aerobatic, four-place Safir is operating in 18 countries as a side-by-side military or commercial trainer as well as a sport-executive airplane. Production is at the rate of five per month, with deliveries about eight months following an order. Currently on order are 20 91Ds to the Finish air force (which is negotiating for 10 more) and 18 to the Dutch government for the training of KLM airline pilots.

HONEYCOMB "EYES" FOR HUSTLERS

AERONCA PRODUCES ALUMINUM HONEYCOMB RADAR REFLECTORS FOR B-58 BOMB-NAV SYSTEM

To withstand the environmental factors of supersonic performance, the Convair *Hustler* utilizes a variety of honeycomb sandwich structures for major airframe and sub-system components. Its bomb-nav system's high-gain radar antennas exemplify these technologically advanced structures.

Aeronca produces the precision parabolic radar reflectors as a D-T-P* "envelope" project, on a subcontract basis. Highly specialized skills and facilities are required to meet their stringent specifications.

A pioneer in honeycomb sandwich fabrications, Aeronca has the versatile, integrated facilities necessary to supply weapon system envelopes *efficiently, economically and on-schedule.*

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*Fabricated to curvature tolerances of ±.005", these precision honeycomb structures illustrate Aeronca's coordinated Design-Tool-Produce capability.

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Operational expansion has created openings for additional senior engineers. Write to W. W. Gordinier, Personnel Manager.

pilot first class Balakina. This 45-year-old pilot, with 25 years' flying experience, "possesses enviable health and endurance, is energetic at his work and shows initiative in flights." The reasons are not incidental, say the doctors; Balakina never takes alcoholic drinks, and "actively prepares himself for flying in everything connected with the medical requirements."

In complete contrast was the case of Lt. Vahrushev, who arrived at his unit healthy, but who "liked to stay out late and to sit with jovial company." Progressively he grew worse, and finally was removed from flying status.

Military pilot second class Capt. Mamchenko "often took strong drinks and broke the preflying regime" say the doctors. Eventually he showed negligence, got more easily tired, avoided flying and high g loads during the flights he did take. He also was removed from flying.

The doctors conclude their article urging clean living, understanding of aviation psychology and physiology, and a plea that the attitude toward aviation medical training be as serious as the attitude toward flying training.

Escape Capsules Designed for B-58

Crew escape capsules, which will separately enclose each of the three flight members of the Convair B-58 Hustler bomber just prior to ejection, are undergoing flight and rocket sled tests at Hurricane Mesa, Utah.

The capsule design permits crew members to fly in "shirt-sleeve" comfort; conventional high-speed gear, including bulky clothing, elaborate pressure suits and large numbers of personal equipment, is not necessary.

A contract for design and production of test capsules has been awarded Stanley Aviation Corp., Denver, Colo. The capsule is designed to permit safe crew bailouts at speeds of 1,300 mph., Convair reports.

After a crew member triggers the mechanism, the capsule encloses him completely. The crew member then activates the ejection system.

After the capsule clears the airplane, a parachute opens at the proper altitude to lower the device. The equipment is designed to provide the airmen with a habitable environment on land, sea or ice. Self-contained radio equipment is designed to locate the capsule for rescue craft.

With Stanley on the project are Bendix Aviation Corp., Coleman Engineering Co., Inc., Cook Electric Co., Cornell Aeronautical Laboratory, Inc., Denver Research Institute, Scott Aviation Corp., Talco Engineering Co., and Temco Aircraft Corp.

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While designing an escape system for their F104 aircraft, Lockheed engineers devised a strap system for man-seat separation, then called upon Talco to furnish the actuating power.

Tested by Lockheed, and further tested by the Air Force, the Talco Rocket Catapult and Man-Seat Rotary Actuator have proven to be the most effective method ever devised for safe ejection at ground level at slow speeds, and at high speeds at altitudes.

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House Group Urges Research Expansion

By Ford Eastman

Washington—House Science and Astronautics Committee has charged that military research and development programs appear to be handicapped by inadequate funds, equipment, personnel and high-level planning despite their importance to national security.

In a report that consolidated the findings of four subcommittees reviewing research and development programs of the Defense Department, Air Force, Army and Navy, the committee said lack of funds and proper allocation of money appeared to be the two principal factors impeding the progress in the military space sciences.

The subcommittee report, which dealt primarily with Army research and development activities, said that, in view of the need for rapid technological advances, research and development money "clearly seems inadequate" at all military levels.

The report said this also includes the amount allocated for research in the total administration budget, funds allocated to the Army within the Defense Department and the sums programed by the Army within its own budget.

The subcommittee said it was not attempting to substitute its judgment for that of the Defense Department in the use of available funds but added that a general condition of "fiscal anemia" appears to afflict Army research and development, in particular.

The subcommittee said progress made by the Army in its research development program has been impressive within the limits imposed by funds, equipment, available personnel and high-level planning. However, the report added that:

• **"Army, perhaps even more** than its sister services, must depend on a comprehensive research and development program to remain effective in combat situations, whether these are global or local. . . . While it may be expected that the most probable active use of the Army in the foreseeable future would be in regard to the so-called brushfire war, the Army must nonetheless depend on extensive new techniques and systems inasmuch as it is almost certain to be far outweighed in terms of the opposition's manpower.

• **"Budgetwise, the Army research** and development program is, at present, just barely getting by. It is significant that Gen. Trudeau (Lt. Gen. Arthur G. Trudeau, chief of Army research and development) feels that the Army is not prosecuting more than half of the possible research areas which might be of genuine utility to the Army.

• **"Amount of research** and development money actually being expended by the Army on basic and applied research . . . appears to be very low." The subcommittee said that about 90% of the Army's research activities will be in the areas of test and evaluation.

• **". . . Army, as well as other services,** is definitely handicapped by a multiplicity of decision levels and by bureaucratic contract procedures which, while designed to assure economy and democratic fairness, are often excessively consuming."

• **Total Army research** and development program is handicapped by insufficient liaison with similar foreign programs and scientists. The report added that all three services also lack facilities for rapid translation and publication of foreign technical reports such as those available in the Soviet Union.

• **"Army has no space program** per se, (but) it has specific interests in space which warrant vigorous and expeditious research in such allied areas as the use of space or space vehicles for communications, weather interpretation, surveillance and reconnaissance."

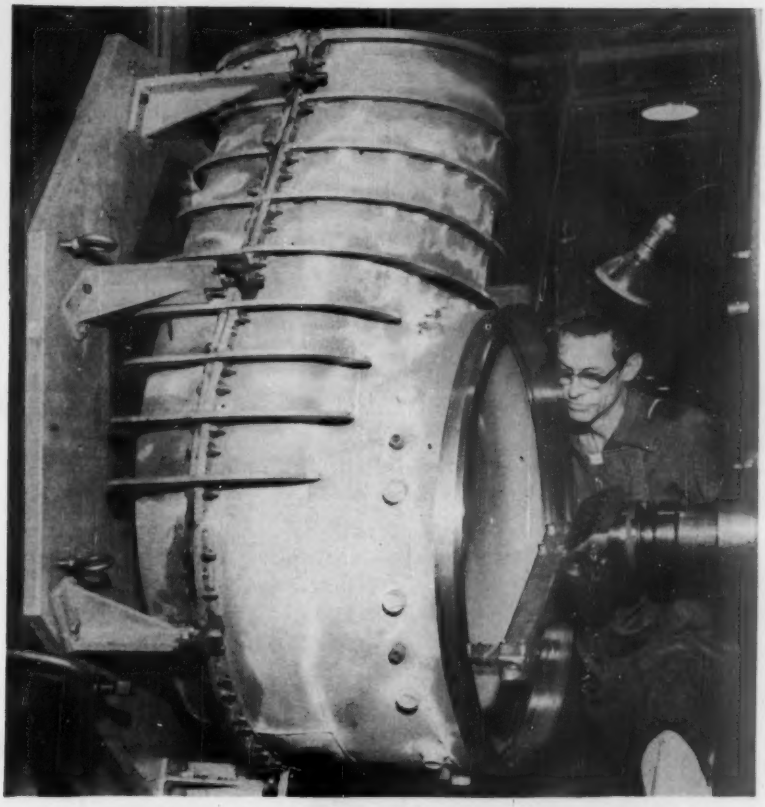
• **Duplication of research** and development efforts in space technology by the military services "is, in fact, essential in many cases" because the "actual capability of all services to use space is still in its formative stages and because so many scientific answers in relations hereto are unknown.

• **"Army is presently handicapped** by inadequate authority to investigate and research certain areas of possible warfare which might be termed 'exotic' or 'unorthodox.' These areas would include, but not be limited to, such concepts as chemical warfare, biological warfare, psychological warfare, decibel warfare and microwave warfare. While the defense establishment is pursuing some of these programs to a point, it appears that they are generally frowned upon from the standpoint of humaneness and public relations. Testimony from reliable witnesses, however, suggests that 'exotic' methods might actually be much more humane than the nuclear weapons which today are taken for granted as a first-line means of defense."

The subcommittee said it recognizes that American processes of democratic government do not give the U.S. the

Flying Weather Laboratory Flight Test

Scientists check the main console of the Boeing 707-120 flying weather laboratory upon completion of its first flight test. The flight, which covered 7,000 mi. at altitudes to 45,000 ft., marked the end of Phase 1 in the Development of the Air Force's AN/AMQ-15 Weather Reconnaissance System (AW Oct. 6, 1958, p. 80). At the moment, plans for Phase II, which would involve prototype development and fabrication, are in the negotiating stage and somewhat uncertain owing to Air Force budget limitations (AW Aug. 24, p. 23). Bendix Systems Division, prime contractor on the project, expects to receive some money for work on the second phase. First phase of the project, which was carried out by Bendix in conjunction with Boeing Airplane Co. as the major subcontractor, ran for 12 months and cost approximately $12 million.



Duct Designed for Nuclear Test Engine

Stainless steel spiral duct for the General Electric X39 nuclear test engine at Idaho Falls, Idaho, is machined to tolerances as low as .005 in. Two scrolls are used in the X39, to collect compressed air before passage to the nuclear reactor, and prior to its return to the compressor section. Ryan Aeronautical Co. imported the boring head from West Germany to machine the flanges on the scroll.

same freedom to pursue its security objectives, especially in peacetime, with the precision and emphasis of nondemocratic governments. It added, however, that certain things can be done to expedite the Army's research and development program. It recommended:

• **"That the Administration review its** budgetary policies at the earliest practicable time to determine if added funds for defense research and development might efficiently be put to use. . . . If more and better research would overburden the national budget, cuts should be more in areas less vital to basic U. S. security.

• **"That the National Security** Council review high-level policies and directives in regard to the 'exotic' or 'unorthodox' methods of warfare and give sanction to stepped-up research programs in these areas where such action may be warranted.

• **"That the Defense Department** review its research and development contract requirements with a view toward eliminating all possible delay in this process.

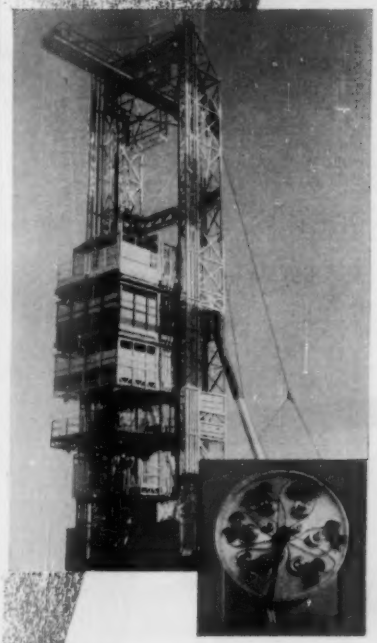
• **"That the Defense Department** confer on a broad scale with industrial leaders and private contractors" in efforts to restrict output of scientific developmental publications which may contain information useful to totalitarian governments insofar as such restrictions may be consistent with traditional freedoms of information and palpable security needs.

• **"That the State Department** and Defense Department immediately take steps to speed up effective liaison with outstanding scientists and science programs in other countries; that the two departments coordinate their efforts to assure greater use of foreign research and scientific talent; that maximum use of such research and talent be made within the United States."

Although the subcommittee which reviewed Air Force programs did not make specific recommendations, it said there is no doubt that the strength of the Air Force is based in large part upon the ability of its research and development effort to take full advantage of scientific progress.

"It seems abundantly clear," the sub-

In Redstone Gantry Tower ...YUBA Instrumentation



When tons of steel gantry tower for the Redstone Missile are raised into position at White Sands, New Mexico, both parallel sections must move at the same speed and at the same exact angle. To eliminate the possibility that stress differences between the two sections might effect the precise movement of the tower to its vertical position, Yuba was commissioned to develop and build the required instrumentation into the tower control. This type of instrumentation is typical of Yuba's contributions in the missile field. Whatever your need, Yuba has the capabilities and facilities to produce to your strict specification—with minimum lead time.

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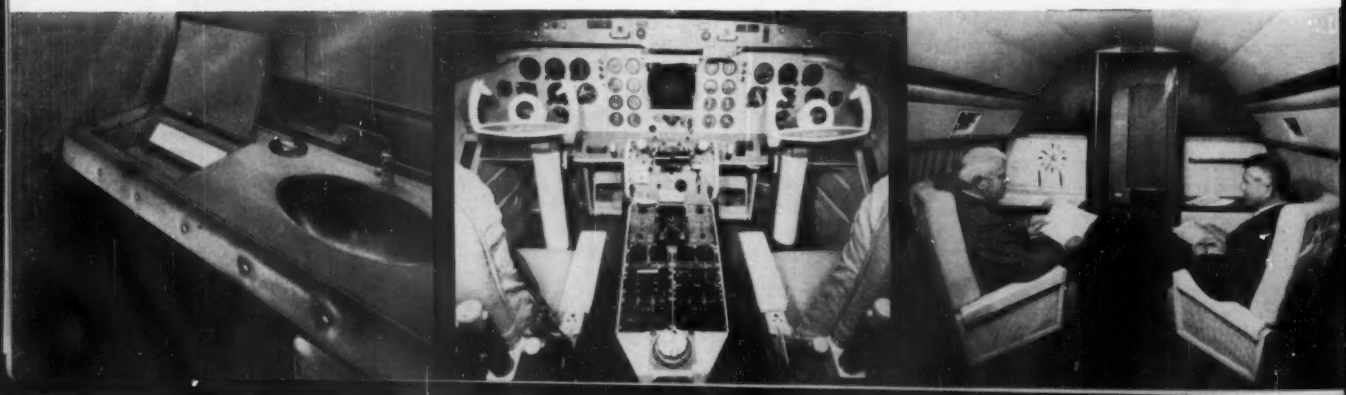

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The Gulfstream has been conceived by Grumman expressly for corporate use. It uniquely combines performance, utility, reliability and safety to make it America's No. 1 Business Aircraft—and, therefore, the logical first choice of leading corporations. It carries 10-12 passengers.

Powered by two Rolls-Royce prop-jet engines, the Gulfstream cruises at 357 mph and has a range of 2600 miles plus reserve. Pressurization at 25,000 feet provides a comfortable air-conditioned cabin altitude of 5500 feet—permitting operation above the weather and traffic. The Gulfstream's ability to get in and out of smaller airports—those with runways of approximately 4000 feet—substantially increases its utility and scope of operations.

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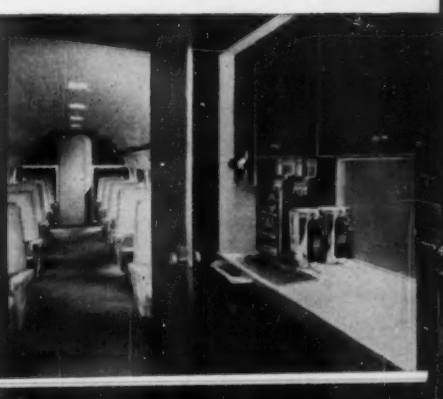

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This transmitter is recommended for use with ARC's line of tunable receivers, (R-13B and R-19) for a primary communication system on small aircraft or as a "back-up" to ARC Type 210 Transmitter-Receiver on larger aircraft.

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UHF AND VHF RECEIVERS AND TRANSMITTERS (5 TO 360 CHANNELS) • INTERPHONE AMPLIFIERS • HIGH POWERED CABIN AUDIO AMPLIFIERS
10-CHANNEL ISOLATION AMPLIFIERS • OMNIRANGE SIGNAL GENERATORS AND STANDARD COURSE CHECKERS • 900-2100 MC SIGNAL GENERATORS

committee reported, "that this ability must continue to have as its foundation sufficient resources and support, dynamic management and organization, and, lastly, trained and qualified people at all levels. Leadtime between concept and reality must continue to be compressed and every possible technique to reduce the time lag must be explored."

The subcommittee also said ways must be sought to prevent loss of scientifically qualified people from the Air Force to industry and that important pools of scientific information accumulating elsewhere in the world must be tapped.

Proposals to Navy

Another subcommittee reviewing Navy programs made the following recommendations:

- **"That Navy funds for research,** development, test and evaluation be raised to 10% or more of the total Navy budget and that half or more of such funds be provided for basic and supporting research."
- **That regardless of budgetary levels,** "greater emphasis be placed on basic and supporting research, component development, electronics and attack aircraft, especially aircraft-missile attack systems."
- **"That the Navy's foreign** contract research program be moderately increased . . . and extended to additional countries, including non-European countries.
- **"That the problem of continental** defense against submarine-launched missiles receive further study, with special attention to the possible prohibition of submerged foreign submarines off U. S. coasts within a distance of at least 200 mi."

PRODUCTION BRIEFING

W. L. Maxson Corp., New York City, will design and build power supplies for the AN/ASQ-28 bombing-navigation system for the North American B-70 Valkyrie bomber under subcontract to International Business Machines Corp.

Leach Corp., Compton, Calif., will develop instrumentation for upper atmosphere probes on an initial contract for over $50,000 for U. S. Air Force Geophysics Research Directorate, Bedford, Mass. Recording system will gather thermal radiation and other data in balloon and missile studies.

Robertshaw-Fulton Controls Co., Aeronautical and Instrument Division, Anaheim, Calif., has received a $118,000 order from Convair for Atlas missile checkout and launch cable assemblies. Fifteen types of cable assemblies will be made.

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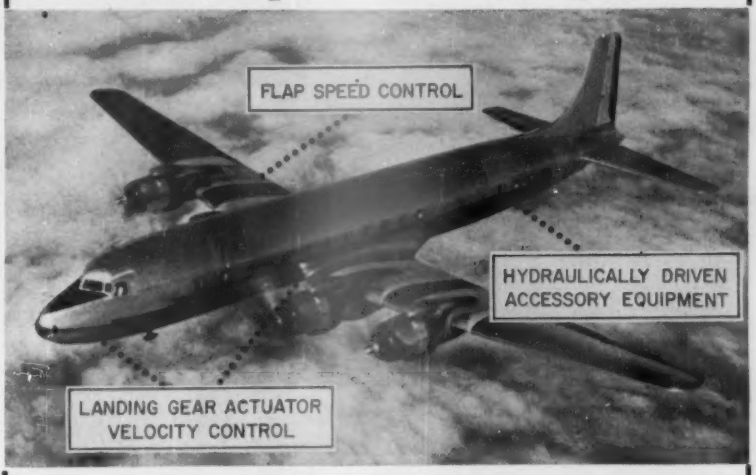
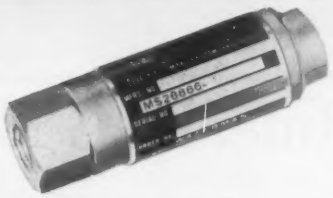
Pressure Compensated Flow Regulators





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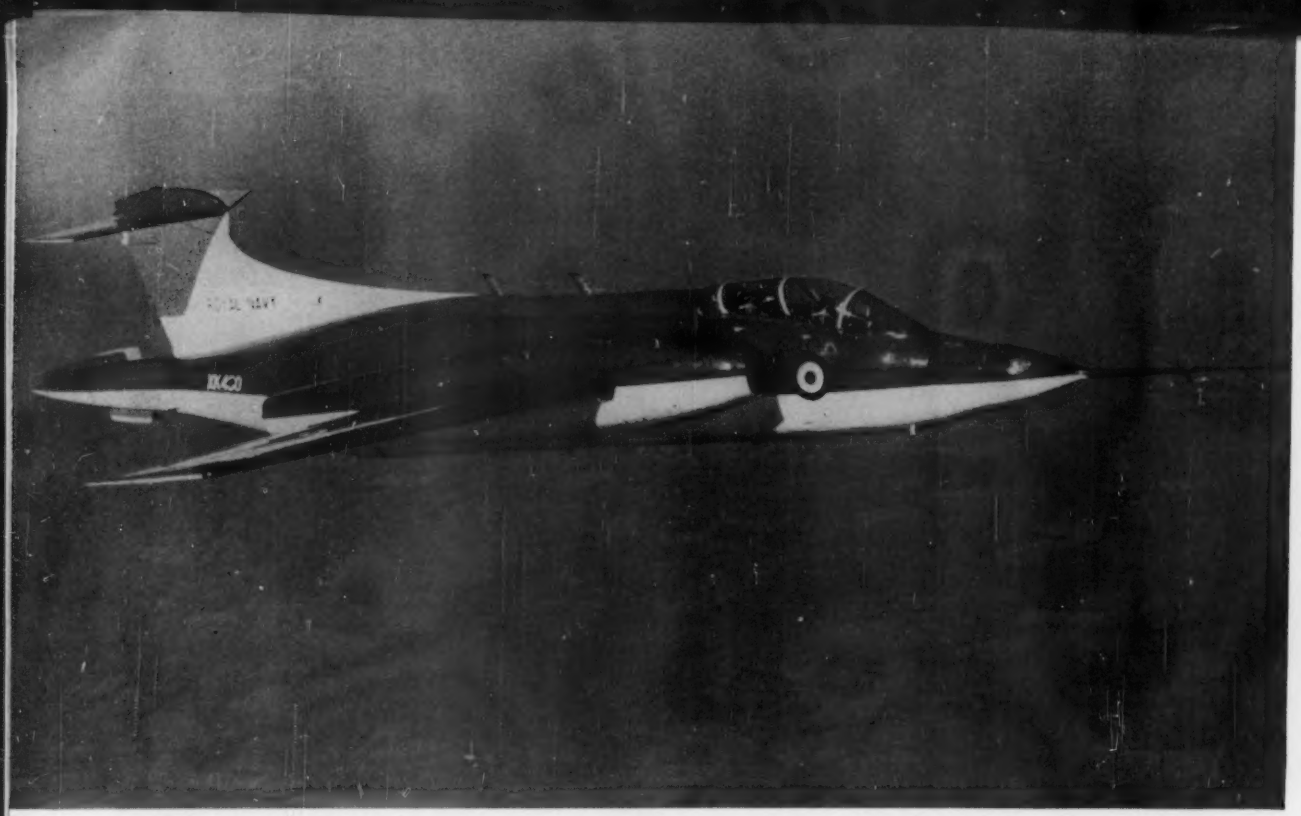


BLACKBURN NA.39 in flight shows the unusual layout of this two-seat, twin-engined naval strike fighter. Plane has been ordered in preproduction quantity of 20 units; expected production order will be for British Admiralty.

Use of Area Rule, BLC Marked in NA.39

Farnborough, England—Blackburn NA.39 low-level naval strike aircraft was the most advanced aeronautical design at the 20th Society of British Aircraft Constructors Flying Display and Exhibition.

Combination of contemporary aerodynamics and structural design details has impressed foreign observers. In-flight performance of the plane, demonstrated during the air show by Blackburn pilots Derek Whitehead, G. R. I. "Sailor" Parker, and John Burns, pointed up the low-level maneuverability and dash capability of the plane.

Seven of a production order for 20 planes are now on flight status; first prototype flew Apr. 30, 1958.

Powerplant for the sonic two-seater is a pair of de Havilland Gyron Junior D.G.J.1 turbojets rated at 7,000 lb. thrust each dry. Engines are bled to give boundary layer control over the wing and horizontal tail.

Major aerodynamic design features are two:

• **Area rule.** One clue to the effectiveness of the application of the area-rule, first developed by then-NACA scientist Richard T. Whitcomb, is the

FLAPS, GEAR, AND TAIL HOOK DOWN, the Blackburn NA.39 paces Aviation Week's photographer in accompanying plane. Plane is painted dark sea blue on uuper surfaces, gloss white below.

TOUCHDOWN OF THE NA.39 emphasizes the low angle of attack resulting from exceptionally high lift from boundary layer control over the wing and horizontal tail. Drag brake at fuselage rear splits open for flight path control during approach. Note weapons bay under belly of plane; all stores are carried internally.

low aerodynamic noise level of the plane during its high-speed passes. While other British aircraft make noises reminiscent of the Indianapolis Speedway on Memorial Day or of heavy canvas being ripped to shreds, the NA.39 flashes by at a deceptively fast pace, almost unhearalded by sound.

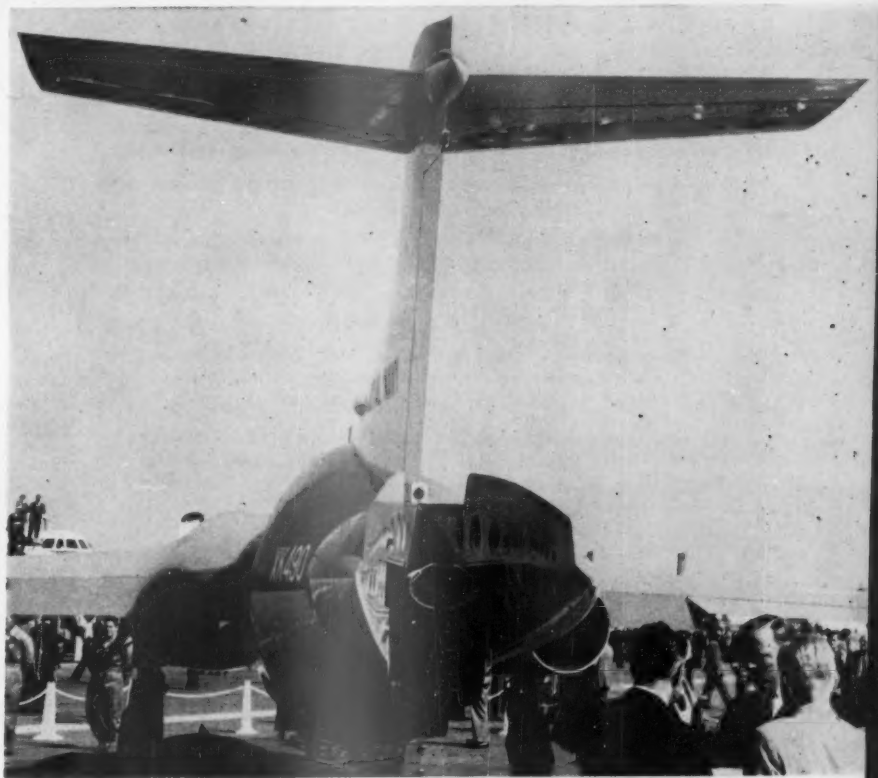
• **Boundary-layer control (BLC).** Available air from the Gyron Junior is bled over the entire wingspan and horizontal tail and gives very high lift coefficient at moderate angles of attack. The NA.39 lands at a noticeably lower angle of attack than its contemporaries.

Secondary Effects

This latter aerodynamic trick has a couple of secondary effects on the layout of the plane. Very short span flaps are used, with a deflection approximating 45 deg., and the rest of the wing trailing edge is aileron. For maximum lift during landing, the ailerons are drooped, so that in effect the plane has a full-span flap system with boundary-layer control.

Because of the high thrust generated during the BLC condition, drag control is used during the approach phase of the landing. The NA.39 has a split drag brake at the rear of the fuselage; the whole tail cone splits on a vertical plane and opens in a vee.

Structurally the NA.39 has broken with precedent, and has been designed



HIGH TEE-TAIL of NA.39 has blowing slot on under surface for extra lift during low-speed phase of flight. Note split drag brake which makes up entire rear fuselage cone.

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FUSELAGE BULGE above NA.39's engine nozzle gives smooth area change. Note inboard short-span flaps. Vortex generators on upper wing surface are of rectangular shape.

from the start with long-life low-level operations in mind.

Integral structure is based on sculptured milling of major components for rigidity.

Long Life Sought

Strength of the structure is not the only design parameter, because it has long been known that any airplane can be disintegrated by flying fast and low. Blackburn's engineering problem was to guarantee a long life for the airframe by detailed attention to fatigue induced by low-level turbulence. Here it had some help from the United States in the form of payment for much of the extremely complex flight-test instrumentation needed to prove out the structure.

Special flutter testing techniques had to be developed, and it was in this specific phase that American engineers were able to make the most effective contribution.

Tactically the NA.39 is intended to operate below the detection limits of radars, coming in on the deck fast and delivering its internally carried weapons by one of the now-standard techniques of toss-bombing, such as the LABS system.

Effective combat radius is on the order of 500 mi., and the avionic gear carried aboard gives the NA.39 all-weather capability.

LANDING GEAR of Blackburn NA.39 is liquid-spring type made by Dowty. Articulated design of aircraft's gear makes for minimum height.

Original Contract

Original contract was signed about four years ago, and Blackburn Aircraft, Ltd., turned out the first preproduction prototype for flight last year on April 30. During the past 15 months, seven of the planes have been cleared for flight test.

The preproduction order for 20 is intended to provide a large number of fight-test aircraft early in the game, so that any problems found during that phase of the work can be solved before full production begins.

Production tooling for the follow-on order is well under way, and there is general confidence that the plane will be ordered in quantity for the Royal Navy.

Over-all dimensions for the NA.39: Wingspan, 42 ft. 6 in.; over-all length, 62 ft. 4 in.; height, 16 ft.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command.

Simmonds Aerocessories, Inc., Tarrytown, N. Y., 131 ea., indicators, liquid oxygen, quantity, type GMU-11/A, Aerno. 46-1001 and 13 ea., indicator sets, liquid oxygen, quantity, type A/A24J-4, Aerno. 46-1004, for: use on T-38A aircraft, IFB 33-600-59-157 (PR EA-9-03K-4521), $79,286.

Philharmonic Radio & Television Corp., New Brunswick, N. J., 500 ea., RT-350/URC-14 receiver-transmitters, depot spare parts and data, end use: personal rescue equipment, (MIPR RO2-990192-SC-01-23 and amendment No. 1), $49,245.

Inter-Continental Electronics Corp., Mineola, N. Y., slow scan converter system, (PR 913256-A-1), $78,351.

Producers Film Studios, Chicago, Ill., 1 ea., production of a 35 mm. Eastman color negative motion picture entitled "Pulmonary Function and Its Importance to Aviation Medicine," SEP 641, (PR EM-9-MP-6412), $31,243.

Instrumentation Division, Ampex Corp., Redwood City, Calif., design, development and fabrication of a final design model of an airborne video tape recorder and incorporation of specification MIL-I-26600, (PR 913204-A), $66,626.

Allison Division, General Motors Corp., Indianapolis, Ind., 32 ea., T56-A-7 turboprop engines for GV-1 aircraft (USMC); 16 ea., T56-A-7 turboprop engines for SC-130 aircraft; 6 ea., T56-A-8 turboprop engines for W2F aircraft (Navy); one ea., T56-A-8 turboprop engine for training (Navy), (PR EP-9-2840-4663, MIPRs R59-1950-57NOas and R59-1951-59NOas), $4,-950,000.

Melpar, Inc., Falls Church, Va., weather data record viewer, AN/GJQ-1(XA-2), spare parts, special test equipment and applicable data, end use; ground support equipment, (PR EC-9-ST-4369), $299,907.

Univac Division, Sperry-Rand Corp., St. Paul, Minn., CU-ARC-58 couplet antennas; CU-ARC-58 control antennas, technical services and reports, end use; service test, (PR 070550), $142,079.

Fairchild Camera and Instrument Corp., Syosset, N. Y., 124 ea., C-7 magazines, spare parts and data, for: 0-23 camera system (end use: RB-47 aircraft), (PR MO-9-6760-2165), $77,994.

Leonard Anderson Associates, Inc., New York, production of a 35 mm. Eastman color negative motion picture entitled, "Maintenance of Microwave Power Tubes," (PR EM-9-MP-6318), $28,624.

Cine Products Supply Corp., Ashland, N. J., replacement parts for AQ-2 JAN projector, end use: ground support equipment, (MIPR R59-02653-SPCC), $67,045.

Bruno-New York Industries Corp., New York, 1,087 ea., C-1464/ARN-31 controls, in accordance with Spec. MIL-R-9486B, dated Oct. 20, 1955, as amended by amendment No. 3 dated Dec. 11, 1957, spare parts, ground support equipment and data, end use: F-101B and F-102 aircraft, (PR's MD-9-5826-37011, EC-9-5826-4738), $36,718.

Defense Electronics Division, General Electric Co., Utica, N. Y., 6 ea., synchronous detection converters, data and reports, end use: service test, (PR EC-9-16A-4701), $85,839.

Sperry Gyroscope Co. Division, Sperry-Rand Corp., Great Neck, N. Y., 398 ea., 4140-289-4277 fans vaneaxial, P/N HD-150/APN-59, Aerno. 81-3207 and data (to be used in C-133A, C-130A, KC-135A, MTU/C-133A, MTU/KC-135 and C-130 aircraft), (PRs MO-9-4140-4708 and MO-9-4140-38029), $30,367.

Motorola, Inc., Chicago, Ill., synchronous single sideband converters and control boxes for service test, end use: service test, (PR EC-9-16A-4364), $82,996.

Kollsman Instrument Corp., Elmhurst, N. Y., 544 ea., indicators, airspeed, type ME-4, Aerno. 50-4939, for: F-100, F-101D, F-102, F-104, F-106, B-57, F-86L and T-37 aircraft, IFB 33-600-59-205, (PRs MO-9-MAINT-34740, MO-9-MAINT-940, MA-9-05C-1081 and EA-9-6610-4818), $241,688.

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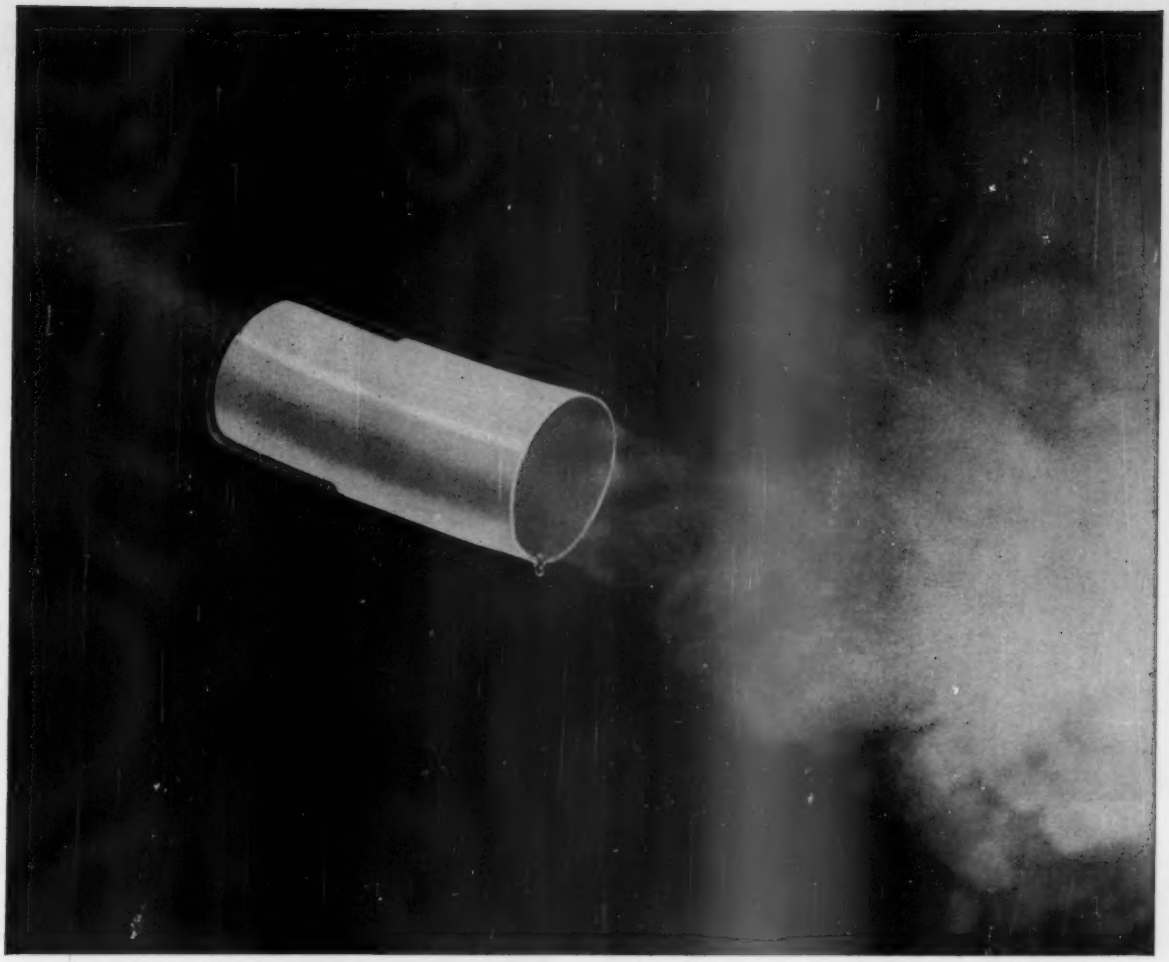

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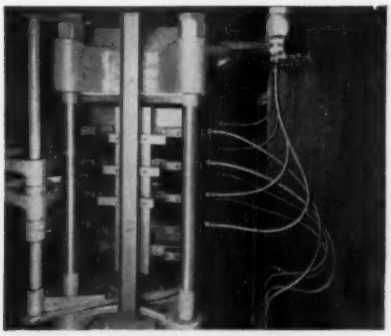

Connections on this platen press carry 350° F. steam and condensate, alternating with 45°F. water. Hoses lined with TEFLON have withstood this service continuously since May, 1955, with no signs of cracking or wear. The anti-stick properties of the TFE resin markedly reduced plugging from scale formation.

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

Hose lined with TEFLON TFE-fluorocarbon resins easily meets the requirement of high-heat resistance, imposed on hose lines by modern flight equipment. TFE resins are rated for continuous use up to 500°F. With overbraiding, hydraulic line pressures up to 6,000 psi are being achieved. In addition, the toughness of TFE resins permits the construction of lighter-weight hose for equivalent pressure ratings resulting in valuable weight savings.

Vitally important, too, is the almost universal chemical inertness of TFE resins. They are completely unaffected by all fuels, oils and hydraulic fluids. TEFLON resins also withstand conditions of continuous flexing, impulsing, and vibration.

No other materials offer this remarkable combination of properties. That's why hose of TEFLON is now standard equipment for hydraulic and fuel lines in many of the most advanced aircraft.

Find out more about how hose lined with TEFLON can meet your requirements for maximum safety and reliability with minimum weight and maintenance. Write to your supplier or: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room T-7921, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

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TFE-FLUOROCARBON RESINS

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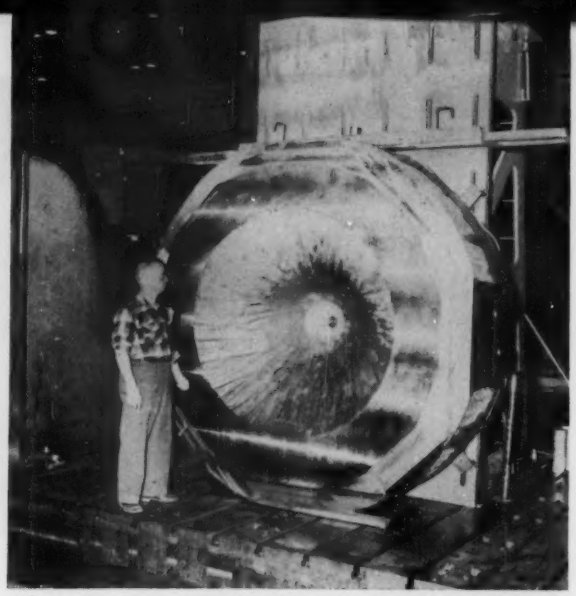
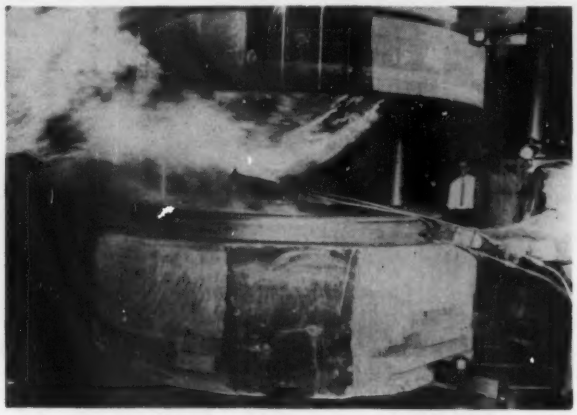
Male die for final forming operation is finish-machined on a vertical boring mill. Dies weigh 35 tons each when completed.



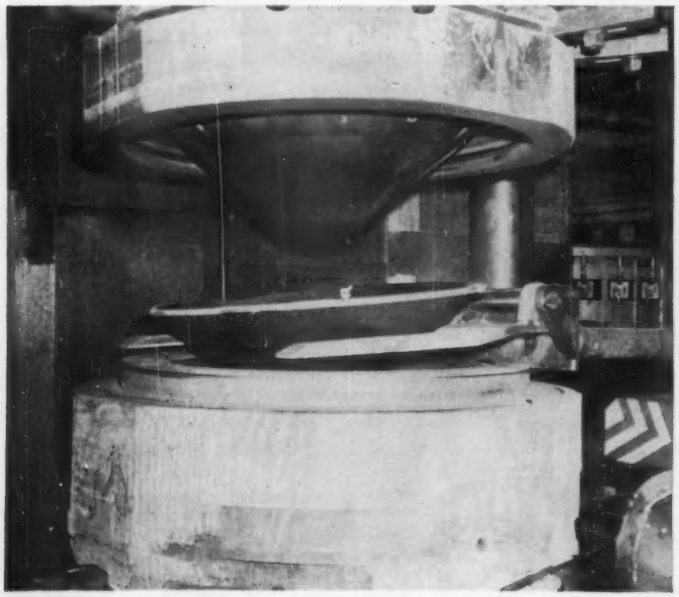
Above, female die is milled. Below, both dies are lubricated in 50,000-ton press before striking operation on nose cone.

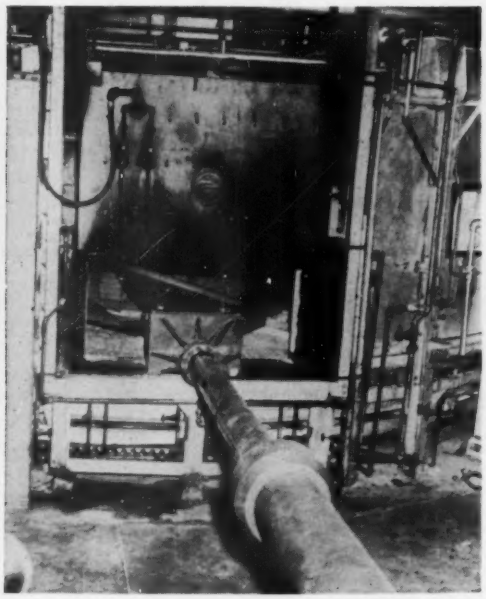
Atlas, Thor Nose Cones Are Closed-Die Forged

Copper nose cones for the Atlas intercontinental range and Thor intermediate range ballistic missiles are formed in Wyman-Gordon Co.'s 50,000-ton capacity hydraulic press in a single pass operation believed to be the largest closed-die copper forging ever attempted. Nose cones are fabricated from 99.5% pure oopper billets of 28-in. dia. Billets are heated and upset to a 30-in. diameter, 9-in. thick pancake in an 18,000-ton hydraulic press. Then the nose cone is partially formed in a second operation on the same press. After cleaning and ultrasonic inspection the piece is reheated to 1,450F in a 30-ft. dia. rotary furnace for the final forming operation on Wyman-Gordon's 50,000-ton press. After final forming, the piece is deflashed and receives a dimensional check. Packing follows an ultrasonic inspection. Finished nose cones measure 5 ft. in diameter, 2 ft. deep, and have a thickness of 1¼ in.



At lower left, finished nose cone is removed from dies. At lower right, nose cone is removed from furnace after reheat.





Up, over, and beyond... this electronic eye stays on the "bird" ...without blinking

Ever try to follow the flight of a low-flying jet as it passed overhead? Near the zenith, you turned and faced the opposite direction—and searched the skies again. So fast did your quarry move, you may have lost it during the second used turning your head.

That's much the way it is with electronic trackers, too. Well known to the radar or telemetry engineer is the requirement for excessive or impossible accelerations and velocities in azimuth in order for the conventional two-axis antenna to track objects passing near the zenith. Heretofore, the standard "solution" to this problem has been to program the gain of the azimuth servo amplifier as a function of elevation angle—a procedure referred to as *secant correction* since the gain must be increased as the secant of the elevation angle.

The Canoga Model 8400 Tri-Ped, a *true* triaxial antenna designed for radar and microwave telemetry tracking, meets this problem head-on and *solves* it with a third axis called *Traverse*. For elevation tracking angles below 60°, the Traverse axis is fixed and the antenna functions conventionally. Above 60° elevation, the azimuth is locked and the Elevation and Traverse axes are used to track until the elevation angle again reaches 60° at which time the system reverts to the basic tracking mode.

Upon resumption of basic tracking the Traverse axis is restored to its zero-center position in a programmed manner. Ambiguities in azimuth data are resolved simply by reversing the sense of the readout at 90° elevation. Raw three-axis data may be used or, alternatively, the unit can be supplied with a coordinate converter whose output is the more conventional two-axis angle data.

For additional information about products of Underwood's CANOGA Division, write Underwood Corporation, CANOGA Division, 15330 Oxnard Street, Van Nuys, California.

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Army Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices.

U. S. ARMY ENGINEER DISTRICT, Chicago, Corps of Engineers, 475 Merchandise Mart, Chicago 54, Ill.

Five Boro Construction Corp., New York, construction of an airmen's dormitory, airmen's dining hall, service club, officer's quarters, officer's open mess and overlot grading and drainage at Richard I. Bong AFB, Kansasville, Wis., (IFB ENG-11 032-95-85), $3,512,537.

Mayfair Construction Co., Chicago, Ill., construction of Air Force National Guard hangar A/C maintenance type B modified and related work at O'Hare International Airport, Ill., base bid and alternates "A," "B," "C," "D" and "E," O'Hare International Airport, Ill., (IFB ENG-11-032-59-102), $1,048,642.

Babcock Construction Co., Wausau, Wis., construction of ground/air transmitter-receiver facility for Antigo AFS, Antigo, Wis., (IFB ENG-11-032-59-76), $117,260.

Food Machinery and Chemical Corp., New York, design and construction of a chemical production plant and munitions filling facility in the vicinity of Newport, Ind., (negotiated by Office, Chief of Engineers, Washington 25, D. C.), $13,235,000.

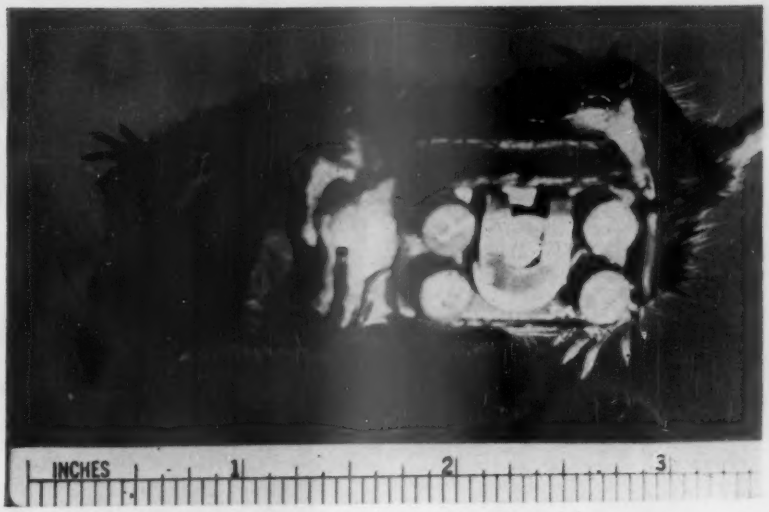
U. S. ARMY ORDNANCE DISTRICT, Los Angeles, 55 South Grand Street, Pasadena, Calif.

Gilfillan Brothers, Inc., Los Angeles, Calif., repair parts, $133,500.

Firestone Tire & Rubber Co., Los Angeles, Calif., guided missiles, $44,800.

Sperry Utah Engineering Laboratory Division, Sperry-Rand Corp., Salt Lake City, Utah, research and development, $17,833,870, and engineering services, $453,357.

Firestone Tire & Rubber Co., Los Angeles, Calif., containers, $35,843.



Viability Sensor Attached to Mouse

Viability sensor attached to mouse for space research was developed at the Air Force School of Aviation Medicine at Brooks AFB, Tex. The mouse-back transmitter was displayed at the 1959 International Trade Fair in Zagreb, Yugoslavia (AW Sept. 14, p. 123)

Sperry Utah Engineering Laboratory Division, Sperry-Rand Corp., Salt Lake City, Utah, Sergeant missile, $14,320,690.

Wallace O. Leonard, Inc., Pasadena, Calif., transducers, $45,750.

Edcliff Instruments, Monrovia, Calif., designs and development, $55,518.

Harvey Aluminum, Inc., Torrance, Calif., development and fabrication activities, $36,982.

Electro-Optical Systems, Inc., Pasadena, Calif., development and fabrication activities, $50,000.

Rheem Manufacturing Co., Downey, Calif., work regarding ZEBRA, $259,842.

Aerojet-General Corp., Covina, Calif., instrumentation and installation, $2,656,573.

Nortronics, Hawthorne, Calif., design and feasibility study, $49,990.

Consolidated Systems Corp., Monrovia,

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Toward the preparation of man for the first steps into deep space, the Martin space medicine research program and space ecology laboratory facilities—now in development at the Denver Division—are among the most advanced activities in the free world. Especially noteworthy is the Martin Lunar Housing Similator. This will be a self-sustaining environmental closed system which will permit advanced study of survival requirements and techniques applicable to airless lunar or planetary conditions.

THE FIRST STEP

Calif., digital acquisition system, $306,775.

California Institute of Technology, Pasadena, Calif., research and development, (1)$54,530, (2)$135,000, (3)$2,491,644.

Motorola, Inc., Scottsdale, Ariz., telemetry sets, $154,927.

Aerolab Development Co., Inc., re-entry body configurations, $115,053.

Hughes Aircraft Co., Culver City, Calif., development radar, $99,633.

California Institute of Technology, Pasadena, Calif., hypersonic research, $30,000.

Convair Division, General Dynamics Corp., San Diego, Calif., research program, $400,000.

Convair Division, General Dynamics Corp., San Diego, Calif., development of radar, $74,963.

Interstate Electronics Corp., Anaheim, Calif., tracking filter development, $187,543.

Servomechanisms, Inc., Hawthorne, Calif., development of control system, $42,199.

North American Aviation, Inc., Downey, Calif., study of satellite rendezvous, $44,990.

Plasmadyne Corp., Santa Ana, Calif., hyperthermal research tunnel development, $99,061.

Motorola, Inc., Scottsdale, Ariz., miniaturization and repackaging of transponders, $138,784.

North American Aviation, Inc., Downey, Calif., airborne digital computing techniques study, $35,897.

Douglas Aircraft Co., Inc., Santa Monica, Calif., adaption kits, and related items (1)$116,503, (2)$475,000, (3)$866,280, (4)$135,726, launching area items, $52,095 and repair parts, $50,882.

Aerojet-General Corp., Azusa, Calif., warhead, $234,614.

California Institute of Technology, Pasadena, Calif., relation between molecular electronic structure and magnetic resonance spectra, $32,310; experimental investigation of strain relaxation under rapidly applied constant stress, $48,600.

University of California, Berkeley, Calif., research in numerical analysis, $40,000; collective model of the nucleus, $25,913; studies of natural and induced radioactivities, $27,046.

California Institute of Technology, Pasadena, Calif., chemical reactions in flow systems, $41,504.

U. S. ARMY ENGINEER DISTRICT, Seattle, Corps of Engineers, 1519 South Alaskan Way, Seattle, Washington.

Eskestrand Brothers Construction Co., Havre, Mont., automatic portion, operations addition, contract DA-45-108-ENG-4865 (IFB ENG-45-108-59-107), $84,300.

Canaday Construction Co., Seattle, Wash., FD radar facilities, FPS-24/24, Cottonwood AFS, Idaho, contract DA-45-108-ENG-4903 (IFB ENG-45-108-59-99), $649,499.

Max J. Kuney Co., Spokane, Wash., FD radar tower, AN/FPS-24/24, Mt. Hebo AFS, Ore., contract DA-45-108-ENG-4905 (IFB ENG-45-108-59-104), $690,600.

George A. Moore & Associates, Inc., Portland, Ore., FD radar facilities, FPS-35/35, Baker AFS, Baker, Ore., contract DA-45-108-ENG-4906 (IFB ENG-45-108-59-102), $658,500.

Leigland Co., Great Falls, Mont., auto maintenance shop building and related facilities, Malmstrom AFB, Great Falls, Mont., contract DA-45-108-ENG-4916 (IFB ENG-45-108-59-119), $356,488.

Charles R. Schmiedeskamp, Portland, Ore., 80/850 kw. power building and distribution system, Mt. Hebo AFS, Ore., contract DA-45-108-ENG-4917 (IFB ENG-45-108-59-103), $532,967.

George A. Moore & Associates, Inc., Portland, Ore., power building, Baker AFS, Ore., contract DA-45-108-ENG-4918 (IFB ENG-45-108-59-101), $563,500.

U. S. ARMY ENGINEER DISTRICT, New York, Corps of Engineers, 111 East 16 Street, New York 3, N. Y.

Samuel N. Zarpus, Inc., and Fullerton Construction Co., (a joint venture), Pittsburgh, Pa., construction of special facilities, Niagara Falls AFB, N. Y. Contract DA-30-075-ENG-8967, $2,655,000.

Standard Roofing & Sheet Metal Works, Inc., Williston Park, N. Y., refueling units, automotive maintenance shop, Suffolk County AFB, New York, Contract DA-30-075-ENG-8981, $94,426.

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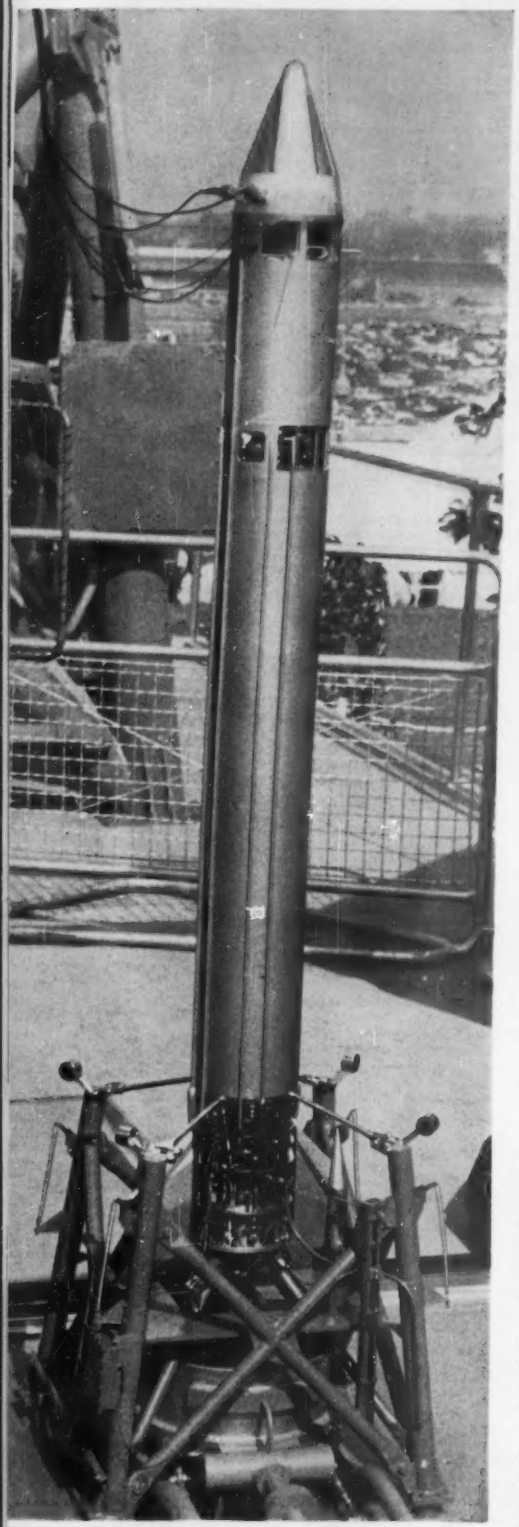
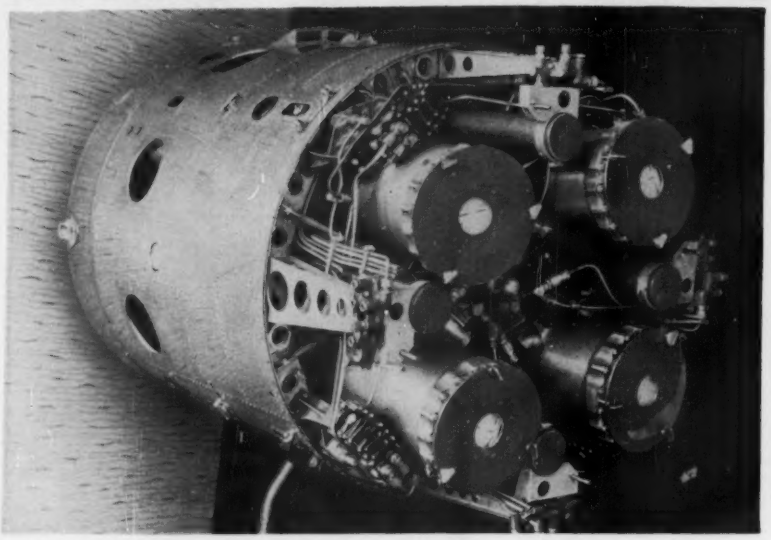


CUTAWAY MODEL of Black Knight shows major internal features of Britain's re-entry test vehicle. Note simplicity of launcher and all holddown and bracing components. Tension springs pull away hose connections, snag sway braces after they separate.



PRODUCTION Gamma rocket engine ready to be delivered to the range at Woomera, Australia, for installation and firing, has nozzles and ports blanked off and sealed with drying agent. Four thrust chambers are gimbal-mounted, produce a total of 16,400 lb. thrust at sea level increasing to more than 19,000 in near-vacuum conditions.

Black Knight Re-Entry Vehicle Engineering Details Revealed

Farnborough, England—First engineering details of the Black Knight re-entry test vehicle were shown in model form at the 20th Society of British Aircraft Constructors Flying Display and Exhibition.

Major purpose of the Black Knight (AW Sept. 22, 1958, p. 50) is to get re-entry data on nose cone shapes and materials for use in the design of the de Havilland Blue Streak, Britain's intermediate range ballistic missile.

Four test rounds have been fired in near-vertical trajectories at the Weapon Research Establishment at Woomera, Australia. All flights were successful and all nose cones were recovered in the desert. One of the cones re-entered from above 500 mi., and at a speed approximating 12,000 fps.

Black Knight is about 35 ft. high, and three feet in diameter. It was designed and built by Saunders-Roe in collaboration with the Royal Aircraft Establishment.

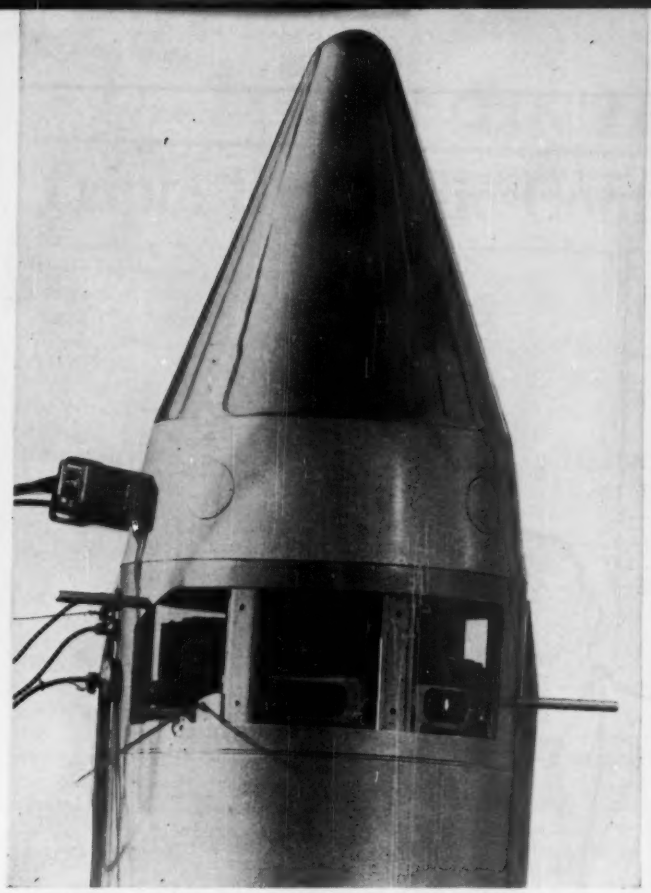
Powerplant for Black Knight is a Bristol Siddeley Gamma 2 liquid-propellant rocket engine based on a design by engineers of RAE's Rocket Propulsion Establishment at Westcott. Each thrust chamber is gimbal-mounted for attitude control of the vehicle during flight. Fuel is kerosene and oxidizer is concentrated hydrogen peroxide.

Peroxide is pumped by individual turbopumps to each thrust chamber, cools the chamber and flows out into a catalyst pack where it is decomposed into oxygen and steam. These are fed into the combustion zone of the chamber. Kerosene feed lines are purged with nitrogen, and only when the pressure rise is sensed in the combustion chamber—due to the introduction of the oxygen and steam—does the kerosene feed begin.

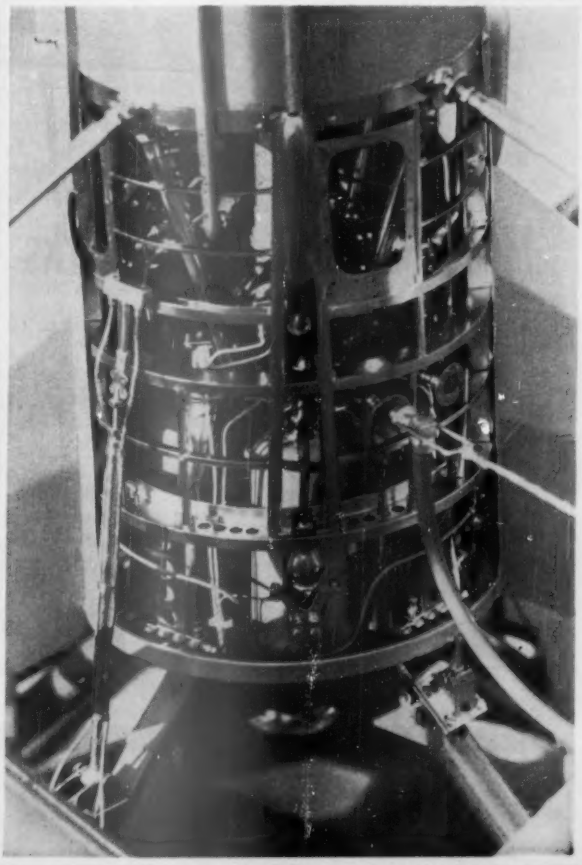
Kerosene and peroxide burn spontaneously on contact in the combustion chamber and initiate thrust. Each chamber delivers 4,100 lb. of thrust for a total of 16,400 lb., which increases to more than 19,000 lb. thrust in the near-vacuum conditions outside the earth's sensible atmosphere.

The photo at bottom right on p. 117 shows the internal arrangement of the Black Knight test vehicle. One of four thrust chambers of the Bristol Siddeley Gamma rocket engine is in the center foreground. Hose at right foreground is for topping off concentrated hydrogen peroxide used as an oxidizer; a simple tension spring guarantees physical separation after initiation by solenoid release.

Sway braces are shown at upper right and left of the picture; holddown tension bar is shown at left. Static load weight of the missile is borne on fittings, one of which is visible at the lower right of the photo, just below the hose.



SOLID-PROPELLANT second stage (above, right) on Black Knight test vehicle may be used for obtaining data at higher speeds by firing on the downward leg of the ballistic trajectory. Single-stage re-entry head of Black Knight (above, left) is detailed in model shot. Note umbilical connections at left with electromagnetic plug for release. Transition section above opened avionic bay, apparently does not separate with re-entry head. Recovered Black Knight test cone (below, left) shows almost straight-in impact. Powerplant bay is below.



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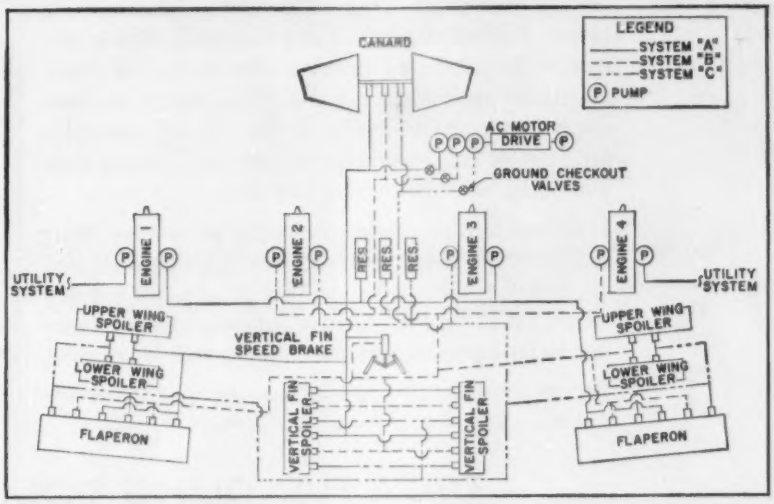
AVIATION WEEK

Triple Hydraulic Control System Studied

Watertown, N. Y.—Flight control of supersonic transport aircraft, requiring continuous power assist, will necessitate a triple hydraulic system, according to studies made by the Boeing Aircraft Co.

At a technical meeting sponsored by the New York Air Brake Co., Robert Abshire, Boeing engineer, described parametric studies made by Boeing for Mach 2 and Mach 3 transports. Much of the work was done in connection with the WS-110A (North American B-70) proposal. The Boeing study indicates the need for increased component reliability at 500F temperatures and 4,000 psi. pressures.

The proposed triple hydraulic system for powering flight controls would permit flight completion after loss of one system and safe flight and landing after the loss of two systems. Horsepower requirements for the flight control system of supersonic transports will total about 170 hp. as opposed to approximately 80 hp. for contemporary subsonic jet transports.



TRIPLE flight control hydraulic system for supersonic transport aircraft is shown in schematic diagram. Each hydraulic system is pumped from two engines of four-engine aircraft, and with any one system operating, the aircraft can effect a safe landing. The delta wing with canard surface is similar to the B-70 configuration. Note the spoilers on both upper and lower wing surfaces and on vertical fin.

Safe Flight Factor

This 170 hp. requirement must be met by any two of the three independent flight control hydraulic systems. However, any one system must provide sufficient hydraulic power for safe flight and landing by supplying approximately one half this horsepower requirement. Boeing's estimate of the maximum utility system horsepower for the supersonic transport is 110 hp.

The company chose a 4,000 psi. system pressure to provide minimum system weight yet not limit reliability. Factors determining system pressure included system weight, ability to fit actuators within surface contours and component performance in regard to minimum leakage and maximum reliability.

Ambient temperatures for Mach 2 flight will reach 210F and for Mach 3 airspeeds will reach 550F. Hydraulic system operating temperature will be maintained by cooling to a temperature chosen for desired reliability.

The cooling means considered by Boeing included water, fuel and combination fuel and water heat sink. Fuel and water heat sink appear to provide the most satisfactory cooling system in terms of system weight at temperatures of 550F, the maximum temperature considered. Other temperature goals include a minimum warmup time and a low temperature limit of −65F.

Boeing found that, in terms of reliability, its triple hydraulic system provided an acceptable failure rate for the least weight increase. Component failure rates, for the purposes of the reliability study, were assumed to be the same as for Class I (−65 to 160F) system operating temperatures. However, as all indications point to increasing component failure rates with increasing operating temperatures, component improvement is mandatory if reliability is to be maintained without complex, redundant systems.

The Boeing study emphasizes the maintenance reliability pitfalls inherent in the use of redundant systems on already complex systems. Reliability studies, again based on component failure rates of Class I systems, indicate that the triple system would achieve an operational reliability of .999991 (nine failures per one million 4.5 hr. flights). This order of reliability is obtained, however, only if all primary and redundant components are operational prior to flight. The same system gives a maintenance reliability of .89001 for a 4.5 hr. flight, which means that after approximately 11 out of 100 4.5 hr. flights some hydraulic maintenance will be required. This hydraulic maintenance increases an airline's maintenance costs and interferes with its flight schedules.

The lack of precise component failure rates at the system temperatures under consideration precludes any absolute reliability findings. However, the study shows that hydraulic system reliability must come through improved component and system design if the aircraft are to be economically feasible.

Improved components and systems are made necessary by the supersonic transport's hydraulic system which will operate at higher power levels than present aircraft, that will influence aircraft safety to a degree comparable to that of powerplants, and will require increased reliability both at the operational and maintenance levels.

Hydraulic Systems

In addition to its work on Mach 3 aircraft hydraulic systems at temperatures to 550F, Boeing is developing 700F components. These high temperature components include hydraulic motors, dynamic seals in both metals and non-metals, servo valves, fluid fittings and hydraulic pumps. Components undergo evaluation in mockup systems at temperatures of both 550F and 700F.

An outgrowth of this component research is the development of a tube fitting for high temperature use which is reported to have good thermal cycling resistance and high fatigue strength. Boeing's "H" fitting, which is similar to other high temperature designs, is one-fourth the weight of an MS fitting. The fitting can be made in a permanent configuration and one that is reconnectable about three times.

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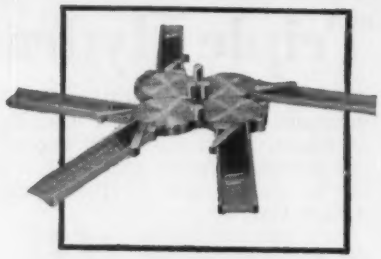

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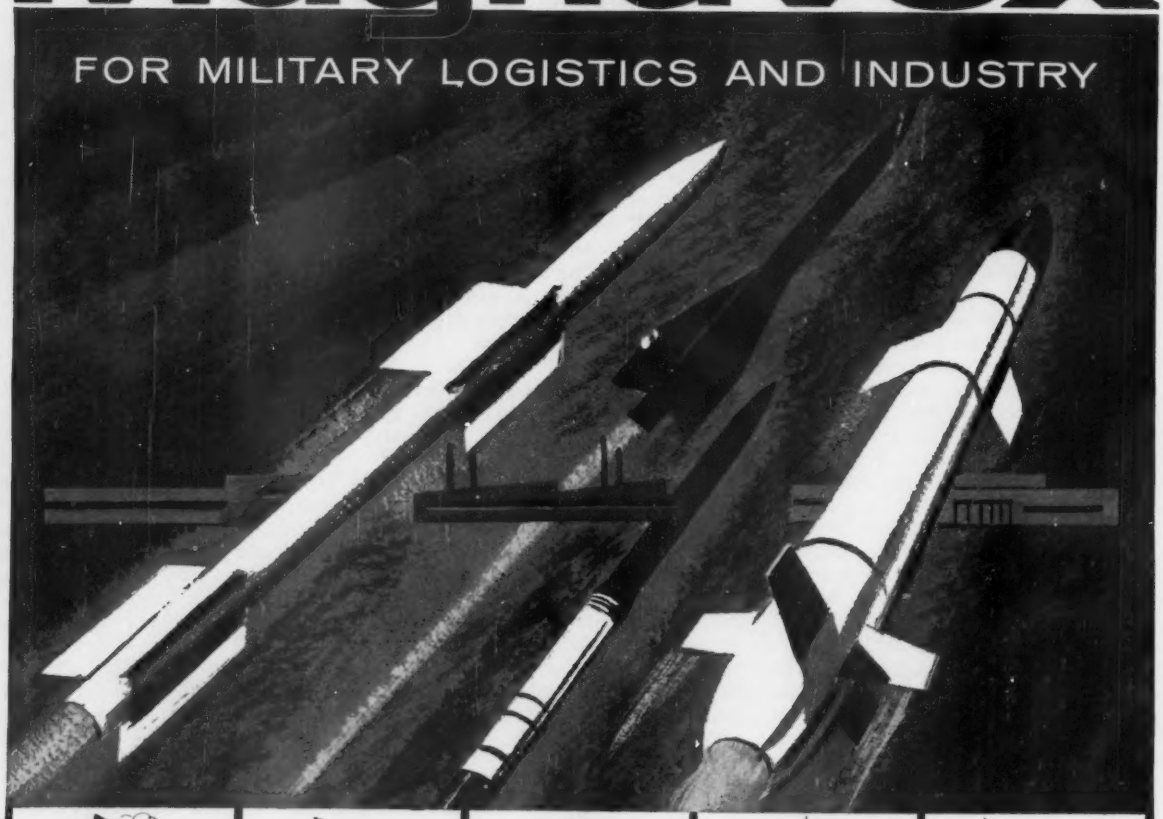

THE MAGNAVOX CO. • DEPT. 112 • *Government and Industrial Division* • FORT WAYNE, IND.

TUBING is enlarged by means of an underwater electrical discharge in a laboratory test of electrical explosive forming. The electrical method is said to be more controllable than high explosive techniques.

Electrical Explosive Forming Tested

Explosive metal forming by means of an underwater electrical discharge is being investigated at Republic Aviation Corp. Successful development of electrical explosive forming could mean the development of small, $50,000 forming tools which could replace hydraulic presses in some applications, the company reports.

Laboratory experiments have developed a shock wave equal to 6,000 hp. from electrical energy discharged in 40 millionths of a second. A battery of capacitors is used to store the electricity before discharge across two underwater electrodes. Republic is attempting to increase force of shock wave by achieving faster current discharge.

The advantages of electrical explosive forming over high explosive techniques is that the electrical method promises more precise control and greater safety. The best area of application for explosive forming is in shaping of high strength metals such as stainless steel and titanium alloys.

Ceramic Material Stable Above 3,500F

General Electric has developed a translucent ceramic that is stable at temperatures close to 3,600F. The material, called Lucalox, is expected to find applications in infrared lamps used to test heat resistance of nose cones, as an electrical insulator, and in bearings. Made from aluminum oxide powder, it is described as a polycrystalline ceramic with a metal-like structure. The small pores normally found in ceramics have been removed from Lucalox.

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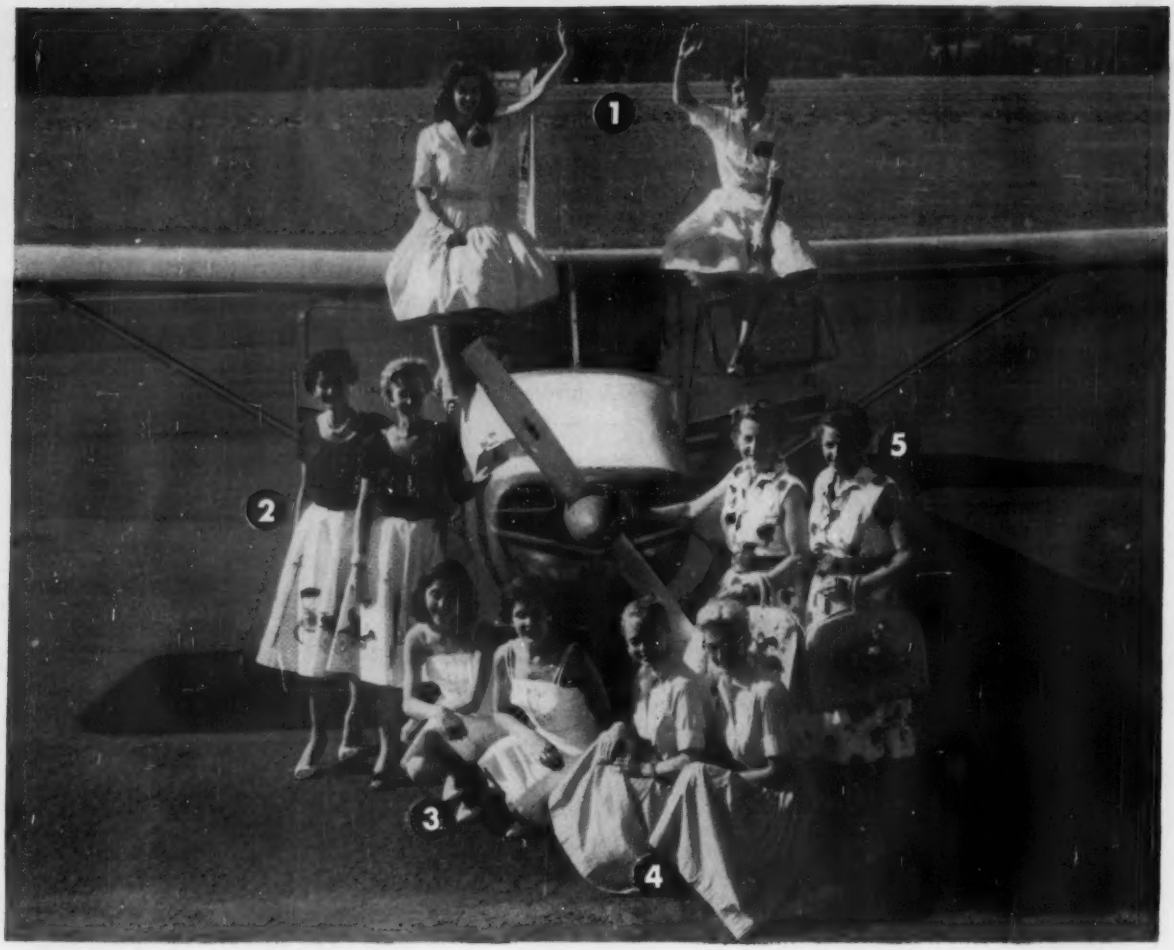

FIRST
Pilot: Aileen Saunders
Co-pilot: Jerelyn Cassel
Plane: Cessna 172

SECOND
Pilot: Juanita Newell
Co-pilot: Jimmye Lou Shelton
Plane: Piper Comanche P-24

THIRD
Pilot: Margo Callaway
Co-pilot: Sandra Callaway
Plane: Cessna 140

FOURTH
Pilot: Marian Burke
Co-pilot: Evelyn Kelly
Plane: Piper PA-18

FIFTH
Pilot: Pauline Glasson
Co-pilot: Ardath McCreery
Plane: Cessna 175

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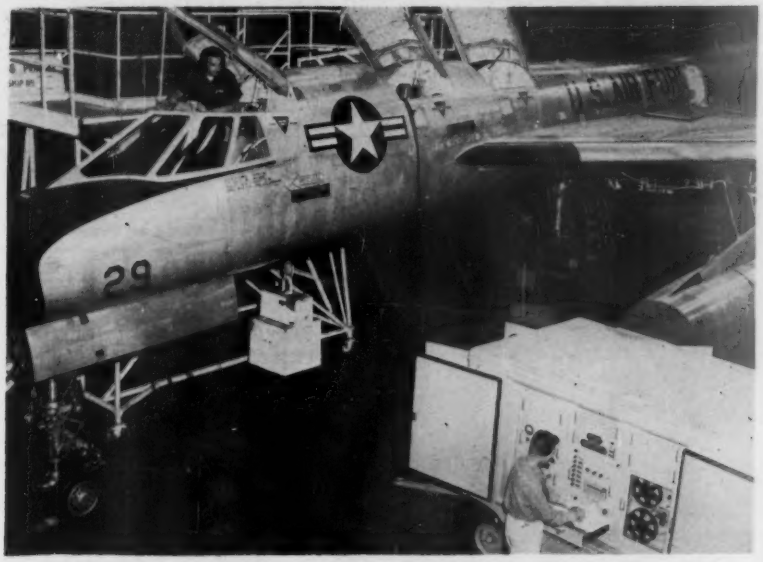
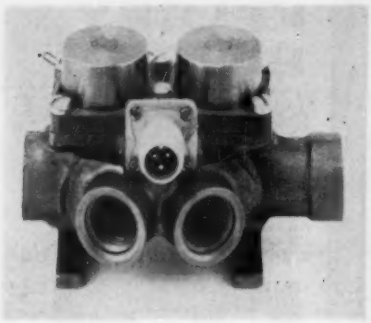


Computer Tests B-58 Flight Control System

Mobile ground support computer is tape controlled to perform 750 tests of the Convair B-58's flight control system in 90 min. The computer electronically simulates flight conditions and command signals sent to the autopilot, and monitors the flight control response. The equipment, operated by two men, gives a "no go" readout. The Eclipse-Pioneer Division of Bendix Aviation developed the computer which is undergoing evaluation at Convair's Fort Worth, Tex., plant.

Solenoid Selector Valve

Solenoid-operated selector valve will handle fluids to 3,000 psi. and up to 275F. Each valve has three positions. Construction is of forged stainless steel.



Each valve position is pressure actuated, eliminating need for springs, although spring actuation is provided as a safety factor.

Hydra-Power Corp., Pine Court, New Rochelle, New York.

Anchor Nut

Self-locking, all-metal anchor nuts are intended for high temperature applications.

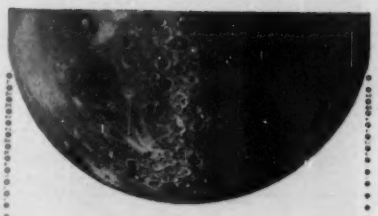
Number F19270 nut is made of A286 stainless for use at 1,200F; No. F19271 nut is made of M252 for 1,400F service. Since the basic nut elements in these floaters are approved parts currently in use—the 1,200F H33 and the 1,400F H19083—retainers may be of any material compatible with the structure to which they may be fastened.

Kaynar Mfg. Co., Inc., Kaylock Division, Box 2001, Terminal Anne, Los Angeles 54, Calif.

Spring Driven Guidance Gyro

Two-degree-of-freedom gyro energized by a wound helical spring provides guidance over a period of several minutes for short range missiles and target drones.

The spin axis of the WG-14 gyroscope is along the pitch axis of the missile; the outer gimbal is along the roll axis, and the inner gimbal is along the yaw axis. A potentiometer pickoff about the outer gimbal axis indicates the angle of roll. A starting signal releases the wound spring which energizes the rotor. When the rotor is up to speed, the gyro uncages. Effective angular momentum is maintained for



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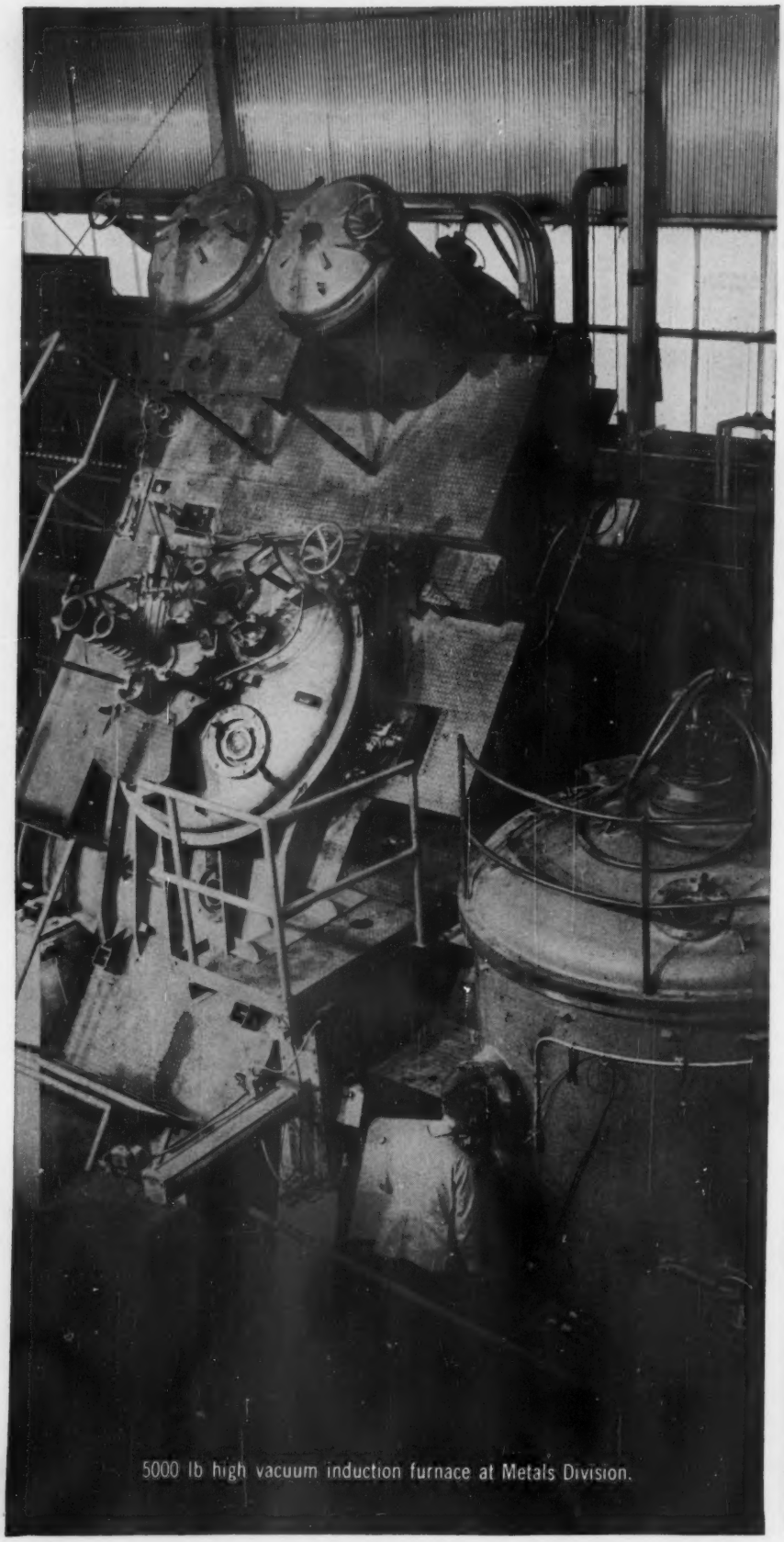

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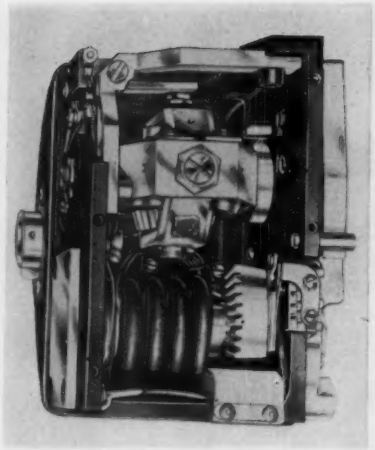

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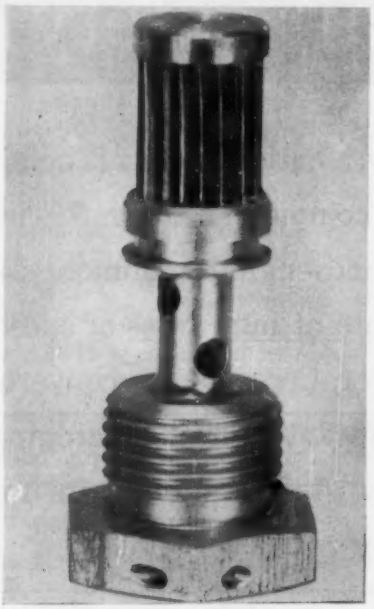
Waltham Precision Instrument Co., 221 Crescent St., Waltham 54, Mass.



Hawk Launcher Hydraulic Filter

Hydraulic filter element, weighing ¼ oz., is used in the Army Hawk missile launcher. The cavity type filter unit contains 4.2 sq. in. of stainless steel wire cloth.

The hydraulic filter is rated for 2 gpm. flow at temperatures from −40 to +275F at a maximum operating pressure of 2,500 psi.

The filter will remove 98% of all particles whose two smallest dimensions are greater than 10 microns and 100% of all particles over 25 microns. Over-all size of the filter assembly is 2⅝ in. long and 1 in. in diameter.

Purolator Products, Inc., 970 New Brunswick Ave., Rahway, N. J.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:

Design Manual for Windshield Jet-Air Blast Rain And Ice Removal—by H. R. Meline and I. D. Smith, Research, Inc. for Wright Air Development Center, U. S. Air Force, Nov., 1958. $6.00; (PB 151595).

Low Reynolds Number Aerodynamics of Flapped Airfoils at Supersonic Speeds—by J. L. Amich and G. F. Carvalho, University of Michigan for Wright Air Development Center, U. S. Air Force, September, 1958. $2.25; 95 pp. (PB 151597).

Ultraviolet and Near Infrared Absorptive Coating Materials and Techniques for Their Application—by D. H. Baltzer and J. F. Dreyer, Polacoat, Inc. for Wright Air Development Center, U. S. Air Force, August, 1958. $.50; 11 pp. (PB 151481).

A Study of Refractory Materials for Seal and Bearing Applications in Aircraft Accessory Units and Rocket Motors—L. B. Sibley and others, Battelle Memorial Institute for Wright Air Development Center, U.S. Air Force, October, 1958. $1.50; 59 pp. (PB 151483).

A Research Program on the Investigation of Seal Materials for High Temperature Applications—by R. H. Baskey, Horizons, Inc. for Wright Air Development Center, U. S. Air Force, June, 1958. $2.00; 74 pp. (PB 151451).

Publications Received:

Flattop—Barrett Gallagher. Doubleday & Company, Inc., Garden City, New York. Photographic account by an official Navy photographer of carrier operations during World War II through the present atomic-powered carrier, the Enterprise. Senior officers of the Navy contribute to various parts of the text. $5.95; 128 pp. 9x12¼.

Airport for Jets—John E. Peterson American Society of Planning Officials, 1313 East 60th Street, Chicago 37, Ill. $2.50; 86 pp. paperbound. Requirements for the location and design of civilian jet airports, the operational characteristics of jets, their effect on the community and the new travel trends.

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from raw data...to air safety

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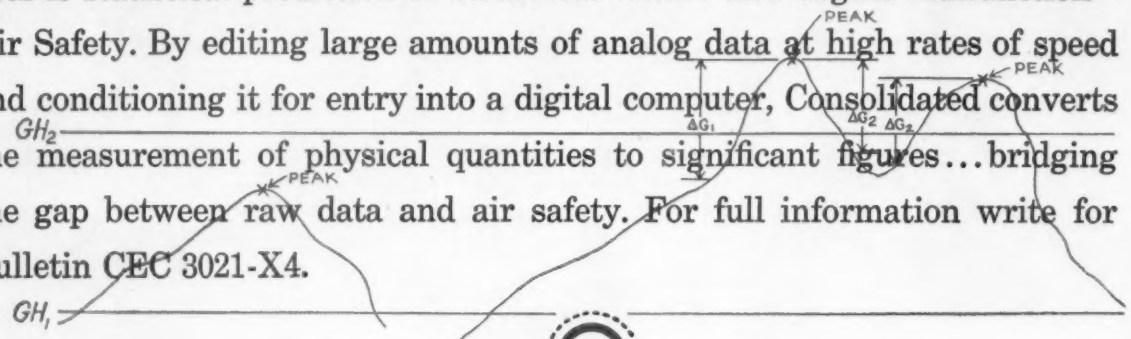
Another Consolidated Systems achievement. Today, a national effort is being made to collect flight load data in military and commercial aircraft. The goal is statistical prediction of structural failure and engine malfunction—Air Safety. By editing large amounts of analog data at high rates of speed and conditioning it for entry into a digital computer, Consolidated converts the measurement of physical quantities to significant figures... bridging the gap between raw data and air safety. For full information write for Bulletin CEC 3021-X4.



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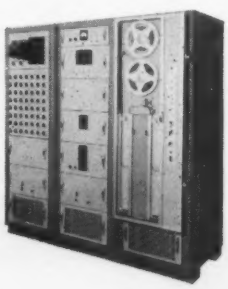

High-speed Translator and Editor System converts analog records to digital form 100 times faster than original recording speed, condensing 50 hours of recording into 30 minutes. Editor digitizes only specified peaks, thereby reducing data by 80 to 90%. These values are recorded for entry into an IBM 705 or Burroughs computer.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Brig. Gen. Don Flickinger, special assistant for Bioastronautics to the commander of the Air Research and Development Command, and **Dr. W. Randolph Lovelace,** adviser to the National Aeronautics and Space Administration, were named recipients of the AFA's Science Trophy for their contributions to the nation's man-in-space program. Each was cited for his part in the biomedical part of Project Mercury.

Maj. Gen. Ben I. Funk, Commander of Air Materiel Command's Ballistic Missiles Center, received the Distinguished Management Award; **Col. Julian H. Bowman,** USAF, Deputy Chief of Staff, Hq. AMC, received the General Management Award; **Col. Carl B. Ekstrand,** USAF, Director of Maintenance Engineering, Tinker AFB, received the Maintenance Engineering Management Award; **Louis R. Koepnick,** Deputy Director for Weapon Systems, Directorate of Procurment and Production, Hq. AMC, and assistant to the Commander, AMC Aeronautical Systems Center, received the Procurement and Production Award; **Col. Robert L. Hohs,** USAF, Chief, Materiel Requirements Division, Directorate of Supply, Hq. AMC, received the Supply Management Award.

The **Tactical Air Command** was awarded the David C. Schilling Trophy in recognition of lightning reactions by TAC's newly-developed, multi-mission Composite Air Strike Force to the Lebanon and Formosa Strait crises in 1958.

Changes

Everard M. Lester, director of manufacturing, American Machine & Foundry Co.'s Government Products Group, New York, N. Y.

Robert G. House, chief engineer and a member of the management staff, Fenwal, Inc., Ashland, Mass. Also: **Stuart Edgerly,** general sales manager.

Howard M. Wittner, project manager-communication satellite vehicle project, General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa.

G. Howard Teeter, general manager, the Martin Co.'s Denver, Colo., Division, to direct operations of a newly created electronics division.

Victor P. Kovacik, research requirements manager, and **M. James Corbett,** development requirements manager, Tapco Group of Thompson Ramo Wooldridge, Inc., Cleveland, Ohio.

Frederick D. Dodge, chief engineer, Minneapolis-Honeywell's Missile Equipment Division, Pottstown, Pa.

Dr. George C. Sponsler, III, senior scientist at Hoffman Electronics Corp.'s Science Center, Santa Barbara, Calif., to head a newly formed systems study group on satellite communications and anti-submarine warfare.

J. Robert Lakin, general sales manager, and **L.C. Wolcott,** director of engineering, Packard Electric Division, General Motors Corps., Warren, Ohio.

In looking... by radar. And in listening or communicating ... by microwave transmission.

Wave-guide switches developed by the TAPCO Group's electronics researchers can shift from one receiver or transmitter to another under full power... a very important point when you're trying to keep an eye on an "enemy," or keep in touch with a "friend," or do both at the same time.

Many types of unique wave-guide switches and components have been developed in the TAPCO Group. And are manufactured by TAPCO for most of the major suppliers of aircraft, missile, and communications systems.

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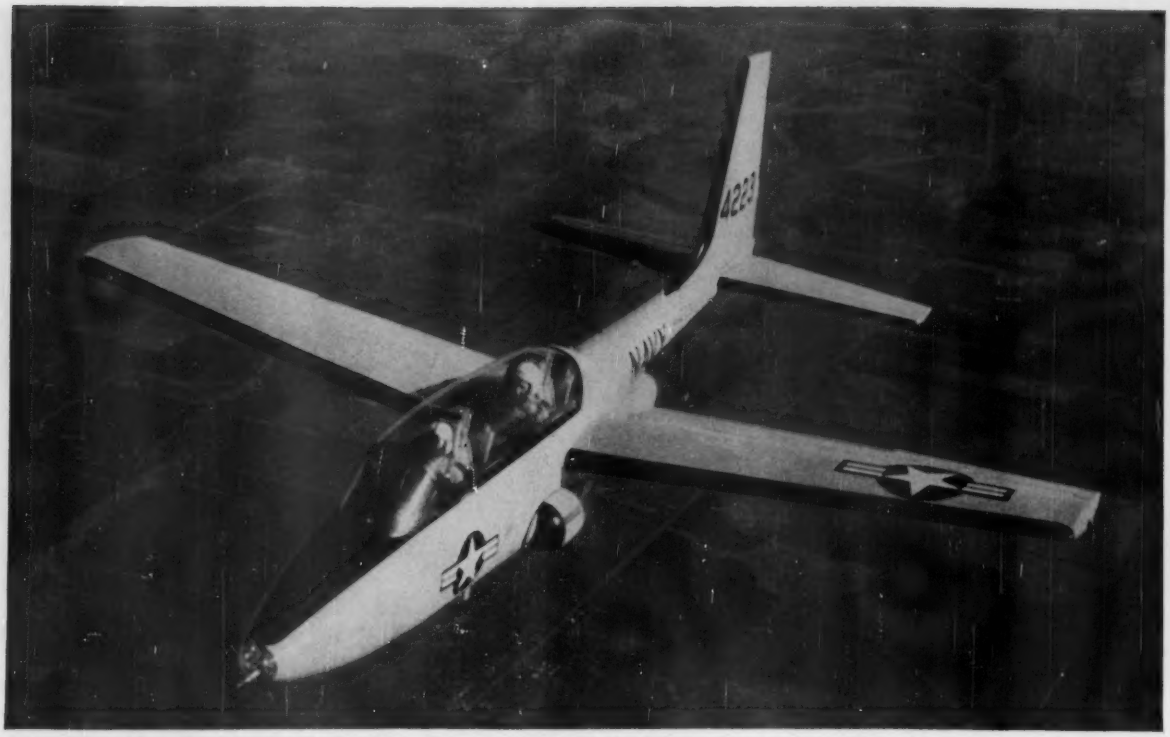


TEMCO TT-1 trainer is redlined at 7.5g positive, 3g negative, 450 kt. indicated airspeed, or Mach 0.75, whichever is lowest.

Aviation Week Pilot Report:

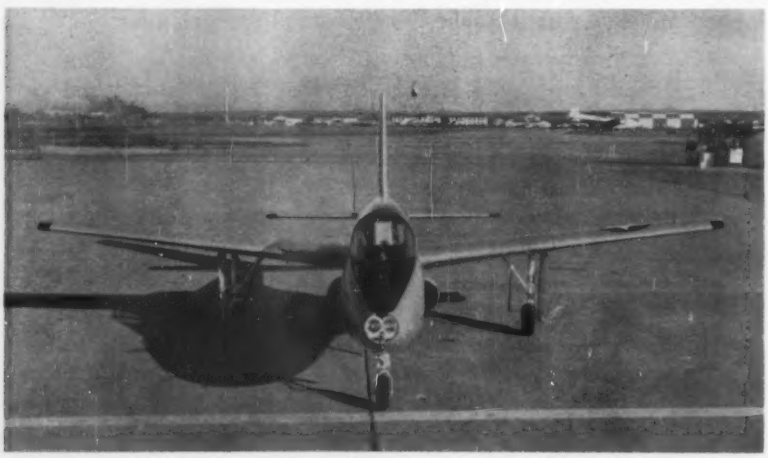
TT-1 Demonstrates Acrobatic Capability

By Richard Sweeney

Dallas—Turbojet powered trainer with the capabilities of the Stearman of past years probably is the best nutshell description of Temco's TT-1 Pinto primary trainer, according to the characteristics and capabilities the aircraft exhibited in an AVIATION WEEK flight evaluation.

Snap rolls, spins, Immelmanns, loops, barrel rolls, slow rolls, lazy eights, pylon eights, Cuban eights, "man on a flying trapeze," split-S, 90 deg. climbing turn rolls—all are easily accomplished in the small midwing airplane powered by a Continental J69 turbojet.

The Pinto does not go anywhere in a great hurry, not even downward in a dive. But where it does go, it goes with a high degree of stability, controllability, good response rates and with light but adequate control forces which do not begin to get heavy until near maximum speeds are reached. It was developed by Temco with its own money to meet a Navy requirement for a "first instruction and solo" training aircraft.



LANDING GEAR on TT-1 can be gravity drop-locked if hydraulic system fails completely.

The TT-1, designated Model 51 by Temco, uses the 920 lb. thrust Continental J69-T-2 engine in current production models. However, flight test has been accomplished for installation of the more powerful Continental J69-T-25 developing 1,025 lb. thrust, which adds proportionately to the Pinto's performance.

Prototype airplane flown in the evaluation is almost identical with the 14 evaluation airplanes which Navy ordered, and is putting through a specially developed syllabus at Saufley Field, a sub-base of the Naval Air Training Center at Pensacola, Fla.

The TT-1 was especially developed to train Navy students from their first airplane ride through solo, and on through a primary training program in all-jet situations.

The Navy also is having cadets first fly piston-powered Beechcraft T-34 aircraft, then accomplish the changeover to the Pinto prior to flying the more

NAVY has ordered 14 Temco TT-1 Pinto primary trainers with Continental J69-T-2 turbojets (920 lb. thrust) for evaluation.

advanced North American TV-2 (Air Force T-33).

Syllabus developed for the TT-1 only program calls for 20 hr. of dual instruction before solo, followed by 18 hr. additional instruction, including some check flights, after solo.

In the Navy program, the first group of 14 students was checked out in the TT-1, while at the same time, another group took its first flight instruction in the T-34. Second and third groups of students will be used in the all-jet versus prop and jet in the Navy program and now are in training with the Pinto.

Navy feeling is that enough features of the latest operational type fighter aircraft are incorporated in the TT-1 for the student to gain a good acquaintance with these equipments early, allowing him to progress through his training faster as time goes on. TT-1 equipment includes an ejection seat, liquid oxygen system, speed brakes, integrated torso harness, plus the features which are unique in operation of a turbojet powerplant.

In addition, the Pinto incorporates those features which are a necessity for any primary trainer, i.e., ruggedness, reliability, simplicity. The airplane appears to be one in which a student may make many mistakes, without the aircraft exacting a more severe penalty than would comparably be paid in a piston engine trainer. Should Navy decide to order the TT-1 into production following the evaluation program, use of the J69-T-25 will give the airplane a much better performance envelope, while at the same time preserving the other features which are so desirable in any primary trainer.

Characteristics and aspects of the TT-1 which received the greatest attention in AVIATION WEEK flight evaluation were those which count the most in a primary trainer. Such things as landings and takeoff handling qualities, general flight characteristics in the basic maneuvers, and acrobatic capabilities were thoroughly investigated, while such things as long-range cruise performance, cruise speeds at altitudes were merely sampled for their relationship to the specifications.

Weather conditions at Greenville,

AVIATION WEEK Pilot-Editor Sweeney is at right; Temco chief test pilot Collis is at left.

Proceed- OPERATION EXPANSION

September 1, 1959 — Raytheon Government Equipment Division today announced a major expansion into five operating subdivisions: Submarine Signal, Airborne Electronic, Systems Management, Heavy Electronic, and Santa Barbara.

Made necessary by expanding product activity, the decentralization has created managerial and technical staff positions in all areas.

Engineers and scientists of established technical competence are invited to investigate the several opportunities present in the area encompassing their particular interest.

Inquiries should be forwarded to Mr. Donald Sweet, Engineering and Executive Placement, Government Equipment Division, Raytheon Company, 624E Worcester Road, Framingham, Mass.

H. R. OLDFIELD, JR.
Vice President & General Manager
Government Equipment Division

GOVERNMENT EQUIPMENT DIVISION

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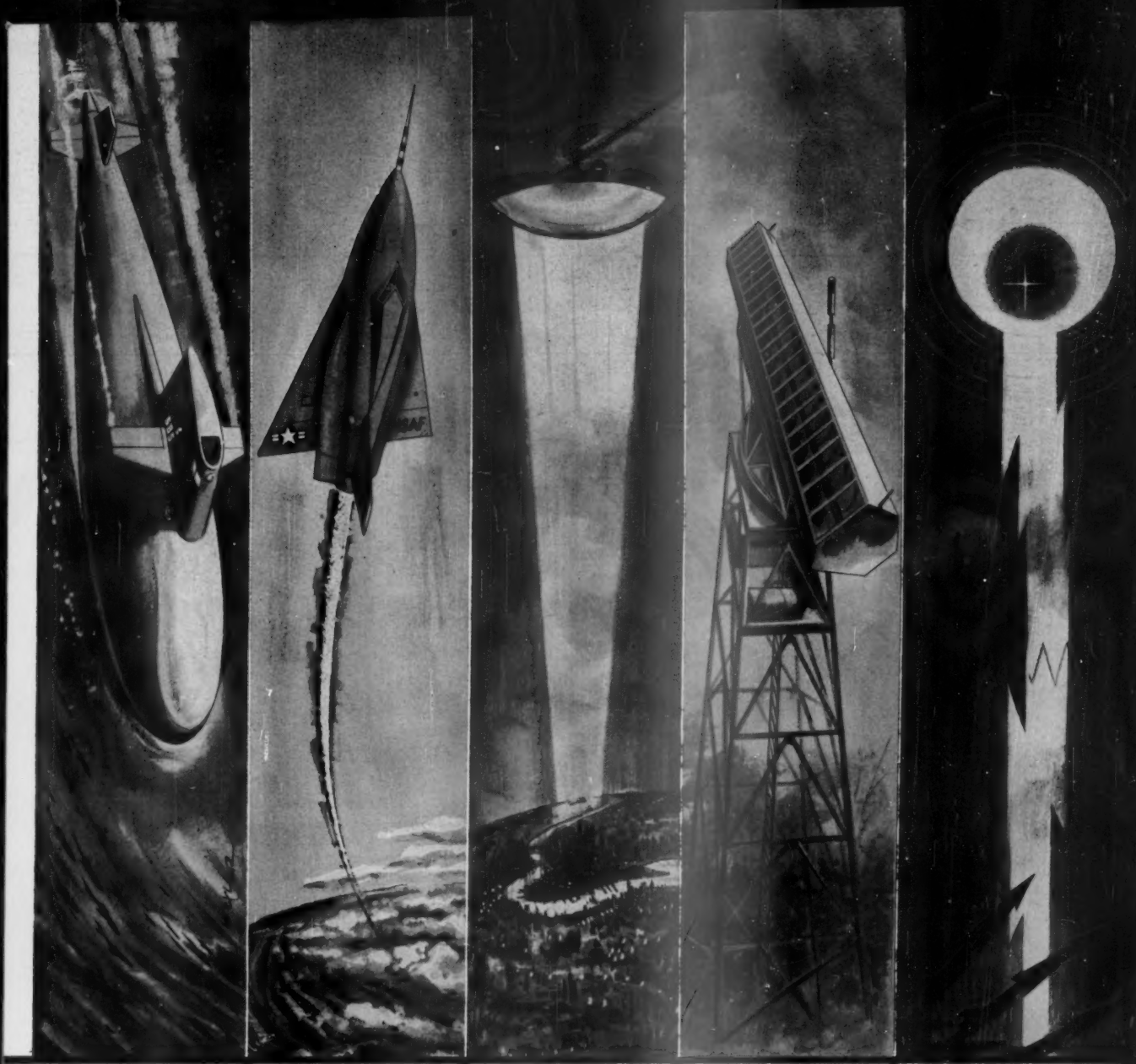

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Newport, Rhode Island
W. Rogers Hamel,
General Manager

Engineering, Marketing, and Production of comprehensive anti-submarine warfare systems. Major products: underwater detection, navigation, communications and fire control equipment.

AIRBORNE ELECTRONIC EQUIPMENT

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Engineering, Marketing and Production of infrared and countermeasures devices. Projects involve active and passive ECM equipment for aircraft, missiles, and satellites, infrared guidance, mapping, and fire control components.

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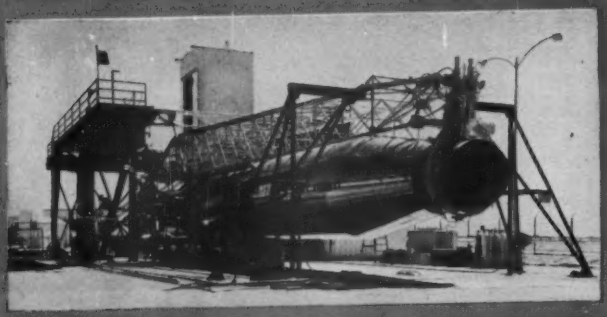

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Day after day, engineering-management people review AVIATION WEEK'S ANNUAL BUYERS' GUIDE in their search for new sources of supply for products, materials and services. AVIATION WEEK'S BUYERS' GUIDE is the industry's recognized buyers' guide covering all segments of the $11 billion aviation industry and its related technologies.

The new 1960 edition is more complete, more up-to-date, more essential than ever before because it provides expanded listings on new products and companies in the new areas of the total market. It will contain over 50,000 manufacturers' product listings divided into over 1,800 specific product categories. In addition to being quick and easy to use, the BUYERS' GUIDE includes complete listings of government procurement agencies telling: Where to go; Who to see; What they buy.

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If you sell to the aviation industry, your advertising message belongs in the BUYERS' GUIDE . . . it will reach over 75,000 key engineering-management decision makers.

Be sure to reserve space in this exclusive issue . . . publishing date is mid-December and closing date is November 1, 1959.

BUYERS' GUIDE ISSUE FOR 1960

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Latest equipment includes an electrically-driven wind tunnel fastest in industry—which produces air flows to Mach 20-plus and stagnant temperatures approaching 16,000°F, with an instantaneous power output of 20 million kilowatts. A spark-heated, magnetically driven research shock tube produces velocities of over Mach 250 and temperatures of 500,000°F. A specially designed electric gun has accelerated projectiles to speeds approaching 20,000 ft/sec.

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Tex., about 50 mi. northeast of Dallas, where flight evaluation was conducted, were typical for Texas during the summer: hot and with fairly high degree of humidity.

Temperatures during both morning and afternoon flight periods averaged considerably above standard, ranging into the high 90F range.

Takeoff Procedure

Normal 20 deg. takeoff flap setting for the TT-1 was used on takeoff. Flaps are retracted after aircraft has reached an appropriate altitude, and speed, usually 105 to 110 kt., indicated airspeed. If aircraft is in a climb attitude, it does not sink but rather flies level for a few seconds as the flaps are retracted and then resumes the climb path.

Taking off with the airplane at a maximum gross weight of 4,400 lb., the airplane was steered during takeoff run with brakes up to approximately 40 kt., at which speed the rudder became completely effective; the aircraft was rotated at approximately 76 kt., and became airborne at 82 kt. IAS. Takeoff run was approximately 30 sec. and covered approximately 1,200 ft. from point of brake release to point of lift-off. The airplane was carrying about 820 lb. of fuel, about 100 lb. having been used in starting and taxi out. Maximum fuel tankage in the prototype allows 920 lb.

Usual climb speed for the Pinto is 170 kt. IAS. A steeper angle can be obtained at a lower airspeed; however, this value has proved most effective in the majority of Temco flight test work, according to Martin E. Collis, Jr., Temco chief test pilot with whom the evaluation was flown.

The aircraft was flown around the field through the landing pattern, sampling landing characteristics at high gross weight. Approximately 780 lb. of fuel remained, which is about a maximum for landing after normal taxi, takeoff and pattern.

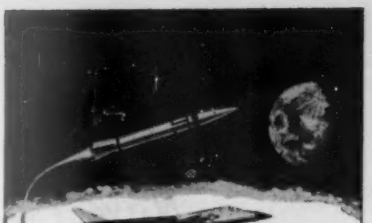
Flight Pattern

The flight pattern used an overhead 360 deg. approach, with the aircraft throttle chopped at the initial pitchout point. Throttle was not used during this pattern; the flap settings, landing gear and speed brake handling were such as to permit landing in the normal position on the runway without having to use throttle around the pattern.

However, due to characteristics of the

Swiss Lightplane Shows High Altitude Potential

Swiss-made Pilatus Porter (AW June 15, p. 101) demonstrates high altitude capabilities in flight tests. Absolute ceiling of the six-passenger lightplane is reported as 27,200 ft. at a takeoff weight of 3,310 lb. At maximum gross weight of 3,965 lb. aircraft will climb to 23,950 ft. Powerplant is a six-cylinder Lycoming GSO-480 rated at 340 hp. Aircraft takes off or lands in 328 ft. at full gross weight; climbs 1,140 fpm. Stalling speed is 43.5 mph., cruise speed 124 mph. Wing tanks hold 68.7 gal., give a range of over 500 mi. Pilatus Porter is intended for general utility duties, including areial photo work. Price will be about $40,000.



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For details, write to:
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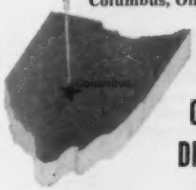

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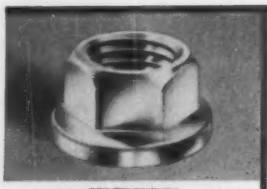
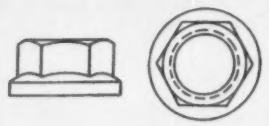
New FN Featherweight locknut series combines minimum mass, outstanding performance



SPS FN-12 Series
Featherweight Hex Locknut



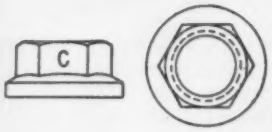
Up to 72% lighter than commonly used sheet metal or AN Series nuts. Tolerance on squareness of bearing surface to threads is 50% less than required by specification, providing reduction in stress concentration. Vibration resistance exceeds MIL-N-25027 requirements by 50%.

Characteristics

Sizes—#4 through ⅛
Tensile strength—160,000 psi on 180,000 psi tensile bolt
Temperature—550°F max.
Material—Alloy steel
Plating—Cadmium

SPS Bulletin No. 2426

SPS FN-812 Series
Featherweight Hex Locknut



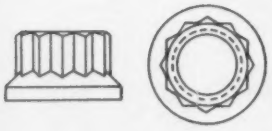
Designed for 800°F service. Corrosion and oxidation resistant; low magnetic permeability. Up to 60% lighter than conventional NAS 679 counterparts. Also less costly because made of austenitic stainless instead of A-286 super alloy.

Characteristics

Sizes—#4 through ⅜
Tensile strength—160,000 psi on 180,000 psi tensile bolt
Temperature—800°F max.
Material—Austenitic stainless
Plating—Silver

SPS Bulletin No. 2521

SPS FN-22 Series Featherweight
12-Point External Wrenching Locknut



Static strength capable of breaking a 220,000 psi tensile bolt. Lightest locknut of this strength available in sizes #10 through 1½. Exceptionally close tolerance on bearing face squareness gives up to 30% longer bolt fatigue life.

Characteristics

Sizes—#10 through 1½
Tensile strength—220,000 psi
Temperature—550°F max.
Material—Alloy steel
Plating—Cadmium

SPS Bulletin No. 2487

SPS FN-920 Series Featherweight
12-Point External Wrenching Locknut

900°F locknut designed for use with high-strength engine bolts having 0.003 in. reduced pitch diameter. Close control of squareness between bearing face and threads makes these the only standard nuts for their temperature meeting squareness requirements of MIL-N-7873.

Characteristics

Sizes—#10 through ⅜
Tensile strength—200,000 psi
Temperature—900°F max.
Material—AMS 6304
Plating—Nickel-cadmium, Silver

SPS Bulletin No. 2504

SPS FN-1218 Series Featherweight
12-Point External Wrenching Locknut

Offers 160,000 psi tensile at room temperature; 140,000 at 1200°F. Reduced stress concentrations achieved by maintaining 0.003 in. bearing face squareness. Simulated service tests document high lock retention during repeated 100 hr. exposure to 1200°F while stressed to 90,000 psi.

Characteristics

Sizes—#10 through ⅜
Tensile strength—160,000 psi
Temperature—1200°F max.
Material—SPS-M-118 (A-286)
Plating—Silver

SPS Bulletin No. 2468

Extensive laboratory tests have been conducted on each design of SPS Featherweight series locknuts to insure their meeting or exceeding specification or application requirements. For bulletins or samples, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium.

AIRCRAFT/MISSILE Division SPS

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J69 engine, engine power was held at 62% rpm., from where the time to acceleration to full power is necessary is considerably shorter than if the engine is allowed to drop below this value, down to 50% rpm. or less.

The TT-1 flies the pattern in a manner reminiscent of the old World War II North American P-51 Mustang fighter. After initial pitchout, the aircraft slowed to approximately 110 mph. at which point the gear is dropped, and, if desired, takeoff or approach flap of 20 deg. The aircraft can be racked around slightly in this configuration, although speed is lost, but still retains excellent controllability and stability and response rate. The airplane is brought across the boundary between 100 and 110 kt. IAS, the nose is rotated upward slightly to slow the speed to approximately 80 kt. which is the flare point, and the aircraft pays off and lands in the nose high conventional attitude at approximately 70 kt. IAS. Aircraft has no tendency to sink and settles onto the runway nicely at this high weight as well as at lower weights.

Following the takeoff and landing at maximum weights, the aircraft was taken off using no flap, with approximately 775 lb. of fuel aboard. Takeoff run from the time full power was reached was approximately 37½ sec. Distance traversed was approximately 3,500 ft. The airplane was rotated at about 85 kt. and came unstuck about 92 kt. IAS.

In the clean configuration, the aircraft accelerates well.

With approximately 700 lb. of fuel aboard, a standard "over obstacle" takeoff was made. In this, the aircraft bettered specifications for distance, and time, even though the specified speeds were observed for rotation, liftoff, climbout.

Following the obstacle takeoff, the aircraft was climbed at the standard initial sea level value of 170 kt. IAS and took approximately 24½ min. to reach 15,000 ft.

In landing and takeoff, especially touch-and-go, the 12 to 14 sec. required for the engine to come from idle to full power seems like a long time. However, the standard length (5,280 ft.) runway is still more than ample for a touch-and-go, including cleanup from full dirty configuration to takeoff configuration.

In a landing which was turned into a go-around, the aircraft was put through approximately all the misfortunes which could happen to a student in his early solo hours. In this, the flaps were retracted shortly after the decision to go around was made and the wheels retracted, the airplane still had not reached full engine power, the go-around was initiated late on final approach, and the speed brakes were left open.

The airplane did not sink to the ground, retained its stability even at the low altitude and high temperature and in fairly rough air, descended from the approximately 30 ft. above ground when the takeoff power was applied to approximately 10 ft. above the runway before accelerating and flying out very nicely.

The second go-around was performed in which the airplane was left in the full dirty configuration, that is, full flaps, gear down, and speed brakes extended. In this the aircraft still retained its controllability and stability, despite the high drag which it was encountering. Performance in this configuration was not high; however, it was well enough above the airplane's stall margin so that any student should not be in dangerous territory should he make all the mistakes in the book while attempting a go-around landing.

In the aerobatic field, the airplane performs well. Loops are entered from approximately 180 kt. IAS, usually, but can be entered up to V_{max}. In this, airplane is pulled up to and held at approximately a 2g climb, which is backed off as the airplane goes over the top. Speed brakes can be used and throttle

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retarded on the down side, or the airplane can be pulled through with full power and no speed brake, without entering an accelerated stall, if the controls are handled smoothly. Airplane will go over the top at approximately 110 to 120 kt.

In an Immelmann, the airplane rolls out nicely at the top. Lack of torque effect and smoothness of the jet's power helps considerably.

For a snap roll, the aircraft actually does a horizontal one-turn spin. If the maneuver is continued, the nose has the tendency to drop as the aircraft reaches the inverted attitude on its second turn around. However, a one-turn snap roll can be performed very nicely.

Good use was made of the tendency to drop the nose, in that the "man on the flying trapeze" can be accomplished very neatly from this situation. (Man on the flying trapeze consists of a snap and a half, a split-S pulled through back up on the other side as in a trapeze swing, another snap and a half, another split-S back out and up again, continuing as long as desired.)

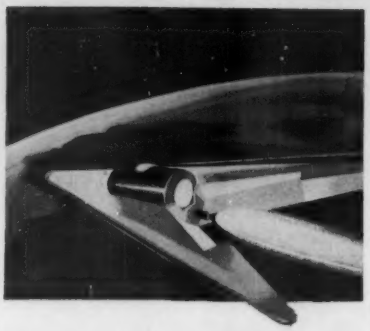
Spin entry and recovery is completely conventional. However, if a spin is entered from a relatively flat attitude, the aircraft fights to right itself after approximately one turn. If the nose is pulled well up prior to entering the spin, the airplane spins very nicely, recovery is effected by full opposite rudder, and the stick neutralized after approximately one-half more turn. In all spinning, however, the stick is retained in the center position laterally. Aileron is not used in entry or recovery.

Both aileron and point rolls (or barrel and slow rolls), are very neatly accomplished by the TT-1. Roll rates are good, and can be varied all the way from very fast to slow. Ailerons do not get heavy until airplane is up close to maximum permissible airspeed.

In climbing turn rolls, which are entered from approximately 150 kt. IAS, the nose is pulled up straight ahead, then the turn is started either right or left, and rather than leveling the air-

Engineer Builds Wingless STOL

Prototype of a wingless air-car, designed to take off in less than 300 ft., will get its lift from the fuselage, which will have more than 100 sq. ft. of aerodynamically useful surface, according to designer Chet Haig, of Irving, Tex., who is building the unusual craft in his garage. The roadable aircraft will be powered by a 30-hp. target drone engine turning a pusher propeller. Haig expects to complete the air-car in approximately six months. The single-seater is designed for a ground speed of 50 mph. and airspeed of 110 mph. Haig, senior advanced research engineer for Bell Helicopter Corp., headed the team which completed feasibility studies on a large nuclear-powered helicopter.



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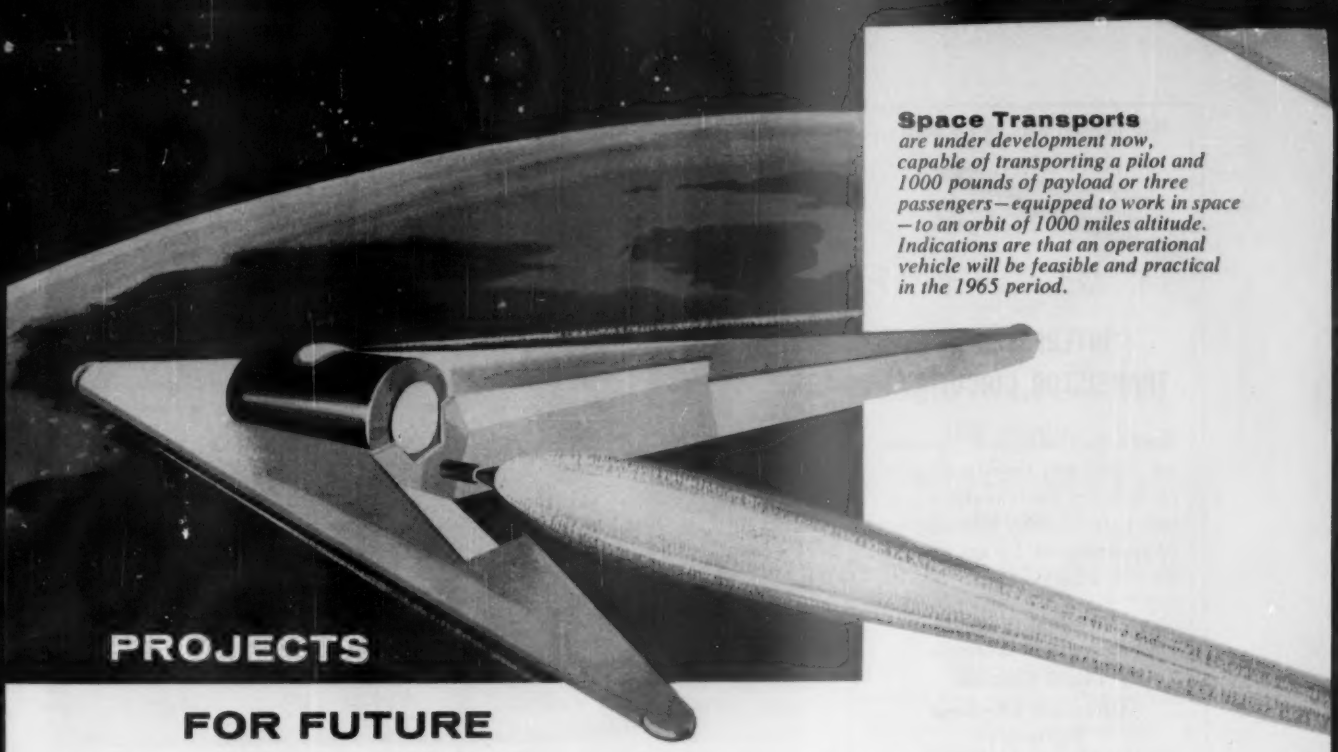


Space Transports *are under development now, capable of transporting a pilot and 1000 pounds of payload or three passengers—equipped to work in space—to an orbit of 1000 miles altitude. Indications are that an operational vehicle will be feasible and practical in the 1965 period.*

PROJECTS FOR FUTURE DECADES IN SPACE... *another Lockheed Progress Report to Engineers*

Plotting the nation's future space exploration projects requires the capabilities of a forward-looking company; one with vision, superiority in technical skills and advanced facilities. Lockheed, Burbank, long a leader in extending the science of flight, is placing its vast resources and accumulated knowledge into programs designed to provide major breakthroughs in the fields of: Basic and applied research; manned aircraft of advanced design; missiles and spacecraft. Shown here are artists' renderings of a few of these important projects. Such project diversification calls for high-level technical skill, offers genuine challenge to experienced engineers. At Lockheed these varied projects require engineers in many fields. Take advantage of this need. Go forward with a forward-looking company: Lockheed, Burbank.

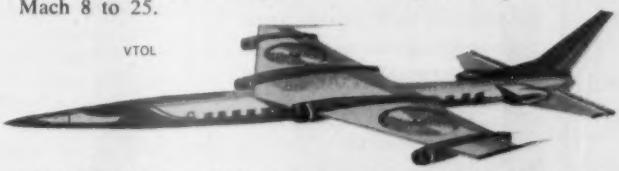
SUPERSONIC TRANSPORT

Supersonic Transports—have held an important place in our thinking for the past several years. Extensive wind tunnel tests have been conducted on many design concepts, supplemented by exhaustive laboratory and structure studies. Lockheed is prepared to build an airliner that will travel at speeds in excess of Mach 3 at an altitude of 75,000 feet.

Infrared Systems studies are being conducted using an advanced method of detecting fast-moving missiles and high-speed aircraft.

High Altitude Flight Vehicle programs have recently been awarded to Lockheed for supersonic vehicles of improved aerodynamic design configurations with speed ranges between Mach 8 to 25.

VTOL



Vertical Take-off and Landing Projects—Lockheed, Burbank, is engaged in exploring the potential of VTOL projects on a very broad scale. Different VTOL features are embodied in each proposal. Considerable emphasis is being placed on VTOL "air recovery" vehicles, designed for air rescue and reentry missiles recovery missions.

Solar Radiation Studies—are being conducted at Lockheed's flight test radio station at Briar Summit, California, placing particular emphasis on solar flares.

Manned Vehicle studies are being conducted concerning fundamental problems associated with landing manned vehicles capable of hypersonic glide or orbit above the earth.

High caliber scientists and engineers are invited to take advantage of Lockheed's outstanding career opportunities. Openings now exist in: *Aero-Thermodynamics; propulsion; armament; electronics—research and systems; instrumentation—wind tunnel; servomechanisms—flight controls; dynamic analysis methods; operations research; electrical instrumentation; physics; antenna; underwater sound propagation; and manufacturing research.* Write today to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 11092, 2400 North Hollywood Way, Burbank, Calif.

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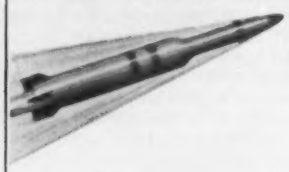

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Floats Extend Capabilities of Heli-Trainer

Floats on Bolkow BO 102 Heli-Trainer (AW July 14, 1958, p. 115) permit student to practice the maneuvers of a helicopter in flight, and to obtain realistic control responses and movements. Hiller Aircraft Corp. has sales rights in the U.S., Canada, Mexico and Central America. The counterbalanced 21-ft. rotor blade is driven by a 40-hp. engine.

plane out, it is rolled through, winds up heading 90 deg. from the original heading, has gained about 400 ft. altitude, and performed the roll. If this maneuver is entered from normal cruise speed, the airplane performs very well.

Smoothness, controllability, stability are excellent throughout all aerobatic regimes in the TT-1.

In the maneuvers which a student would learn first early in his primary training, i.e., chandelles, lazy eights, pylon eights, turns across the road, the airplane performs very well. In chandelles the airplane will gain approximately 700 ft. altitude in the turn.

Lazy Eights

In both lazy eights and turns across the road, the airplane's high degree of controllability and stability show up very well. If the aircraft is properly handled, which is not difficult to accomplish, minimum control pressures are required for either of these maneuvers.

The airplane can be flown through the top of lazy eights at approximately 90 kt. IAS, and altitude lost or gained is according to how much airspeed is allowed to build up through the bottom of the maneuver.

In turns across the road, performed during the heat of the day when turbulence was high, the airplane retained a very good pitch axis controllability despite turbulence. Lateral stability was excellent through the turning period; the aircraft rolled very smoothly from left to right turns.

Maximum acceleration reached in the TT-1 during the flight evaluation was 5.5g positive acceleration.

In stalls, the aircraft is honest, has a light stick shake and airframe buffet approximately 3 to 5 kt. ahead of stall speed in clean configuration.

In addition, in the full dirty configuration, there is elevator buffet prior to the stall. Lateral control throughout both dirty and clean stalls, as well as rudder (directional) control, is more than adequate.

When stall is power off or power on, the primary difference is one of the degree of altitude which is gained between start of the maneuver and the break point; also, the speed value at which the stall break occurs is lower with power on than with power off.

In accelerated stalls, the aircraft again gives good buffet warning.

Red lines on the airplane are 7.5g positive, 3g negative, 450 kt. IAS maximum speed or Mach 0.75, whichever is lowest. Engine temperature limits in flight are a transient exhaust gas temperature maximum of 690C for 3 sec. Reaching absolute maximum temperature of 718C calls for an engine change following the flight.

Engine can be run at maximum tailpipe temperature of 676C for takeoff thrust for 5 min., at military rated thrust for 30 min., with a 636C maxi-

mum tailpipe temperature, while normal rated power occurs at 576C maximum tailpipe temperature. Overspeed limit is 103% during acceleration; however, any overspeed in excess of 105% rpm. calls for an engine change.

For emergency procedures, the airplane's maximum glide range speed is 120 kt. IAS in the clean configuration. In this condition, from 25,000 ft., the airplane can slide approximately 60 mi. For a dead engine landing, which was simulated with the engine at the appropriate rpm., the airplane is flown through the pattern in a conventional manner, except that lowering of full flaps is delayed until the pilot is sure of the landing. However, landing gear and takeoff flaps are lowered as soon as the airplane reaches a normal position over the field prior to landing. In an engine out landing, approach speed over the fence is 90 kt. IAS, approximately the same as for an approach with the engine operative.

Starting the TT-1 is simple. Battery switch is turned on, the throttle is left closed, fuel boost pump and shutoff valve, which both operate off one switch, is turned on and the starter switch is moved to start, where it is held for 2 sec. This initiates the starter's automatic cycle, during which it usually will run the engine to 10% rpm., at which point the throttle lever is moved forward and outward to the ignition point where it is held. Ignition or lightoff usually occurs within 30 sec. or by the time the engine has reached a 15% rpm.

Tailpipe temperature is monitored during the lightoff; after the engine is definitely lighted off and running, the throttle is allowed to move to its normal spring loaded position at idle. Inverters and generators are turned on after the engine has stabilized at idle rpm. of 35 to 40%.

During a start, if the tailpipe temperature exceeds 815C, a hot start has occurred, the engine is shut down and then inspected prior to another starting attempt. If the tailpipe temperature exceeds 790C but does not reach 815C, the start is logged and after three starts in the 790C to 815C range the engine must be inspected. Experience has shown that very little trouble is encountered in this area with the J69 engine.

Canopy on the TT-1 is manually operated for closing and locking and there is a lever on the left side just in front of the pilot which is pulled and locked.

The TT-1 is not pressurized, since its normal flying altitudes are 15,000 ft. and below. "Altitude" is approximately 10,000 ft. for the little trainer.

All maneuvers in the Pinto can safely be performed between 7,500 and 10,000 ft. above the ground. In fact, it has been demonstrated that a one-turn spin can be performed starting at 1,500 ft. above the terrain with the airplane still above 1,200 ft. after complete recovery has been effected.

In keeping with the mission of the airplane, systems on the TT-1 are simplified as much as is possible in a turbojet-powered airplane.

Hydraulic system is a constant pressure type, with an engine pump supplying 1,500 psi. constant pressure to operate landing gear, flaps, speed brake. A hand pump is incorporated for emergency operation of the landing gear doors as well as the wheels. Operating the landing gear emergency release handle closes a valve in the system which routes fluid to a one-way, one-time-only circuit which opens the doors and lowers and locks the gear in sequence. The brake system also operates from the main hydraulic reservoir; however, the standpipe is lower than the hydraulic hand pump and engine driven pump standpipes, thereby ensuring a fluid supply for the brake system even if the main hydraulic system fluid is exhausted through broken lines in other parts of the circuits.

Hydraulic system incorporates a reservoir in addition to the emergency hand pump, which is located on the lower left vertical face of the left hand cockpit console.

Should the hydraulic system fail completely, the landing gear can be gravity drop-locked by pulling the T-handle in

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the forward lower center of the cockpit, ahead of the control stick and below the instrument panel. Yawing the airplane accomplishes a gear-down-and lock position check while pitching locks the nose gear.

Electrical system also is simplified, and essential instruments for all-weather missions can be operated off the battery in the production model airplanes. However, in case of electrical failure, or after engine failure, normal procedure calls for pulling the generator and inverter switches and other circuit breakers to relieve the electrical system drain on the battery.

According to TT-1 project engineer James Forteith, several convenience items were changed in the 14 Navy models, from the experimental prototype Model 51 flown in AVIATION WEEK evaluation.

One change which was made was in relocation of the aircraft emergency fuel system switch from the top of the throttle where it is located on the prototype airplane, to a switch in the central portion of the main instrument panel on the production models. TT-1 uses three integrally connected bladder type fuel cells in each wing, plus a sump tank located in the fuselage, below the level of the other tanks, and just above the engine, providing for a gravity feed system in case of engine pump failure.

Sequence has fuel flowing from the outboard tank into a smaller inboard tank, thence to another large inboard and forward tank, from which fuel drains into the main supply line from both sides, then flows back and down from the wing to the sump tank.

With the emergency manual system provided, the aircraft can be switched from its normal primary fuel supply to the manual system which is essentially nothing but a gravity feed system. However, in flight, the aircraft cannot be switched from the manual system back to the primary, once the changeover is made.

The airplane carries a total of 124 U. S. gal. of usable fuel while total fuel capacity is 127 U. S. gal. This was changed somewhat in the production airplanes which carry less fuel, in view of the mission requirement. However, the airplane can stay aloft at least 1½ hr. in a normal primary training flight, with the supply of fuel carried in the production models.

An additional improvement expected when the Continental J69-T-25 engine of 1,025 lb. thrust is incorporated is a reduction in the acceleration time from idle to full power, the interval expected to drop from 12 to 14 sec. to less than 9 sec. This in addition to the greater thrust, would give the TT-1 an excellent margin of safety in go-around and such other maneuvers as are normal to a primary training syllabus.

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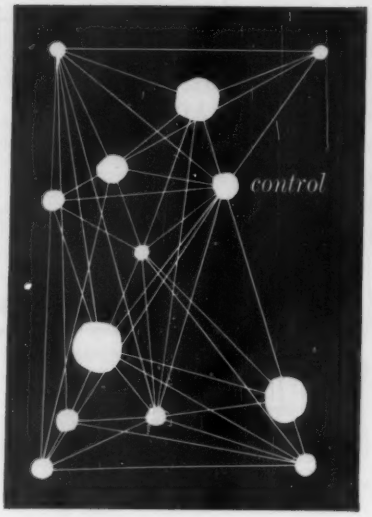

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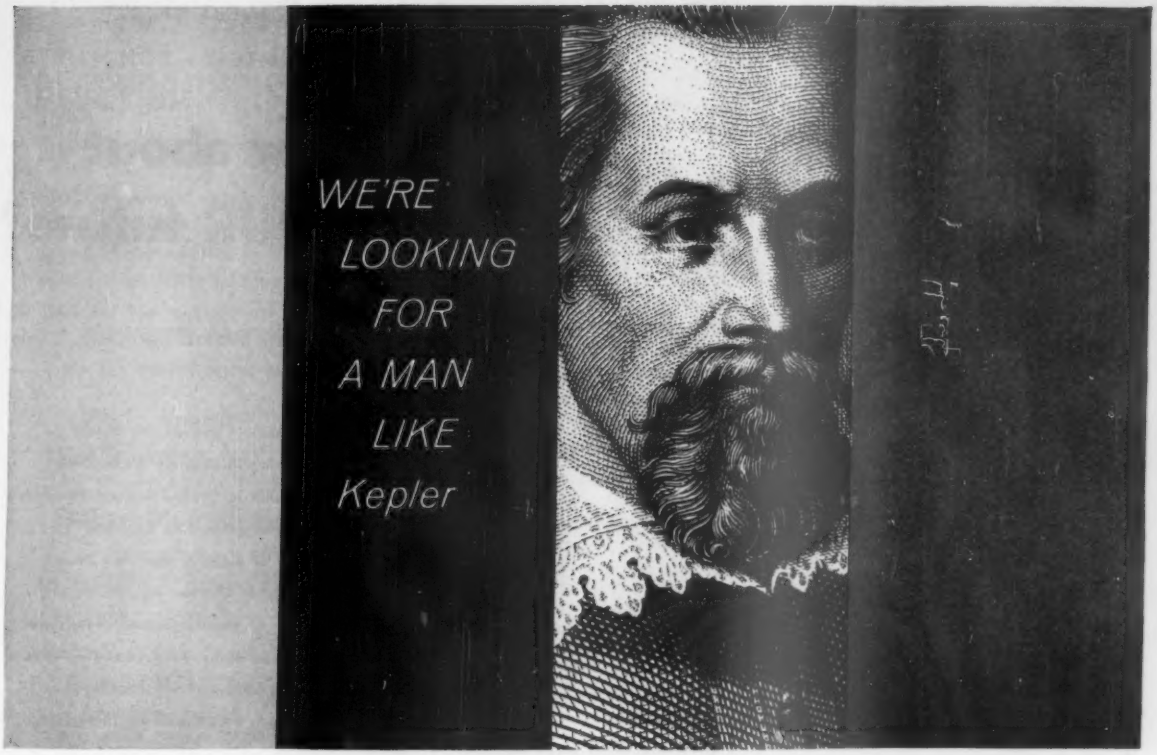

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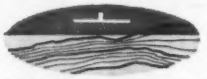
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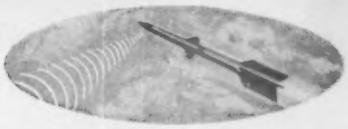

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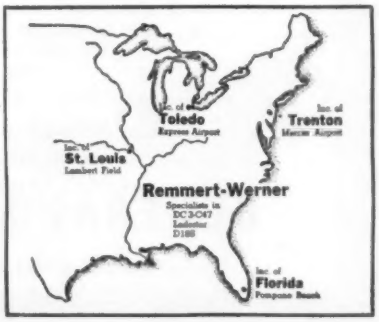

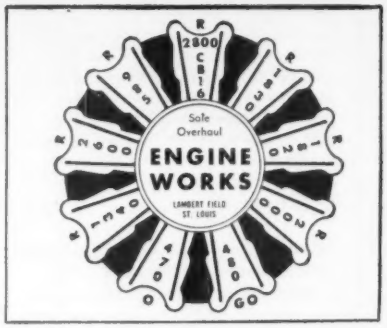

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LETTERS

Airline Earnings

I congratulate you on revealing the fact in your Airline Observer column of Aug. 31 (p. 51) that it takes only one railroad (Union Pacific—$30.2 million; Atchison, Topeka and Santa Fe—$30.6 million) to earn more money during the first six months of 1959 than all 12 certificated airlines combined for the same period.

The airlines have a large jet bill to pay, in addition to earning sufficient surplus and dividend money. If the CAB feels that the meager $60,000,000 net the airlines earned in 1955 is too much, which incidentally precipitated the fare investigation, how can the airlines pay for the jets on "mouse trap" earnings? The airlines should be earning a minimum of $300,000,000 per year, or at least five times the figure the CAB thinks is too high.

As this CAB devastation has been victimizing the airlines with red figures and poverty earnings for more than 20 years, don't you feel it is time for a more realistic regulation of the airlines?

J. Lee Burneston
Larchmont, N. Y.

Selecting Managers

The technical manager referred to herein is, in the specific sense, the division manager, department manager, and the first line supervisor, all of whom are responsible for the successful accomplishment of a complex technical program essentially commencing at the completion of the research phase and continuing through manufacturing and into the operational area. The role of this highly specialized individual manifests itself as the "hinge" upon which the success of such a program revolves. With this as introductory background, the primary concern of this letter will be broached in a frank, open, straightforward manner; namely, the selection process involved in choosing a qualified technical manager has faltered, today, yesterday, and probably tomorrow. The net effect, which seems to result from selective blindness, is not only a watering down of the nation's position in highly critical defense areas, but it is also creating a morale problem that for chivalrous reasons remains carefully cloaked in the turbulent folds of an undercurrent, suppressed only by the thin membrane that comprises the code of human dignity and ethics. In abruptly speaking out on this issue, it is hopeful that the theme of this article will serve to bring into sharp focus that which has been relegated to the nooks and crannies of the technical limelight in the form of unrest and passive resistance.

The qualified professional man who exists and is available, if sought, is being too readily bypassed in the name of expediency and a myriad of other gold-plated platitudinous excuses while the professional brainpickers and "technical" tongue-wagging politicians are worming their way into the scene. Of course, this all takes place in relative innocence under the harmless guise of what is honestly considered a well-thought-out and orderly plan of action. In the meantime,

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

the garden path becomes littered with Russian ballots and the tools of evaluation lie rusting in the crib. On the sidelines, however, sit a segment of those who recognize this situation, but remain powerless to individually overcome its tremendous inertia. The only course left for those is acquiescence with its attending frustrating side effects until a point of diminishing returns is reached—at which time another good man may become lost, if for nothing else, through sheer discouragement and disdain. This represents a vicious cycle that must be curbed. A most reasonable solution to all of this exists. It is relatively simple and of democratic origin. The tools for evaluation are available. Use them for their designed purpose. The dividends from such an approach can be enormously rewarding. Employ the principles of Management Selection. They are thirsting to be used.

This letter has been purposely aggressive, for an atmosphere of complacency and mediocrity is too easily established and maintained. It is human to tend to see those things that are looked for, but evaluation of potential managers must go beneath the surface. Delusion accompanied by "halo effect" is a powerful imposter. Let's pass out the nation's future to the deserved on a competitive and truly selective basis. Selection of technical managers must be treated as a science, not a fad to be tampered with by well-meaners—its far reaching effects go deep and contain the future of our country.

V. Tory
Lockheed Aircraft Corp.
Missile Systems Division
Sunnyvale, Calif.

Age vs. Proficiency

I would like to comment on the letter written by "Airline Pilot," Los Angeles, Calif., in the Aug. 10 issue (p. 134). Some of his suggestions have a foundation of evidence to back them up, while some lack available evidence to support them, and many suggestions were not made that do have substantial evidence on which to act.

> Making a mandatory retirement age of 55 for all pilots in command of all jet aircraft is completely without foundation, and would not base the command assignment on proficiency. On the contrary, it would eliminate pilots with superior proficiency simply on the basis of an arbitrary chronological age; certainly there would be cases in which the pilot who was being eliminated (that is the word) was more proficient than the younger man who was taking his place. The suggestion does not include any test to determine this relative proficiency. The present seniority eliminates no adult by law on grounds other than physical performance and professional ability. Every captain must retain and periodically demonstrate his physical and professional ability. As there are more would-be captains than jobs, a system must be used to determine which pilots shall have the opportunity to prove that they can perform up to the standards of proficiency as set by the FAA and the company. Seniority is a system that says that pilots shall have the opportunity to be tested for captaincy in order of their length of service with the company. It does not make them captains simply on the basis of length of service. It does give them the opportunity to try to pass the tests on that basis. The same is true in checking out on a new aircraft. While this is not a perfect system, and sometimes pilots who have not had the opportunity to check out may be somewhat more proficient in some aspects of flying than some who have been checked out, it is as likely to result in the highest possible pilot group level of efficiency as any other proposed system. It does ensure one factor that is recognized as an asset, and many people consider it the most important single factor—experience! Boeing's Tex Johnson's suggestion that command assignment be based on proficiency rather than seniority sounds good, but it ignores the fact that the so called seniority system is based on proficiency as well as seniority.

I have worked for companies whose boast it was that their system of promotion was based on ability rather than seniority. In every case promotions were based on the opinion of one man as to who was the most efficient, and was highly influenced by personal likes and dislikes. The fact is that there are no means available for accurate grading of pilots among pilots who meet the standards. For one thing, the most skillful pilot is not necessarily the safest pilot. Many people, including check pilots, are influenced by skill demonstrated by a given pilot in some phase, such as greasing on landings, forgetting that this has little bearing on how safe a pilot he really is. Young pilots particularly are apt to judge other pilots by such abilities, rather than the demonstration of sound judgment. A pilot may demonstrate superior technique in landings, etc., and be very dangerous because he insists on proceeding with something like a low circling approach simply because the law allows it, although sounder judgment would dictate that with the particular aircraft and conditions an alternate airport should be used. Do check pilots, including the FAA and Tex Johnson, have the tools for predetermining this kind of judgment? I think not. The present system, while not perfect (few things human are), is fundamentally the best system available.

Ernest G. Marquis
Chief Pilot
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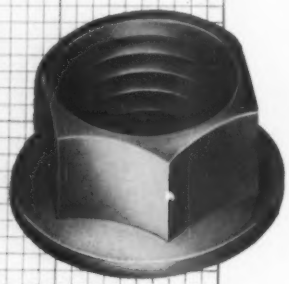

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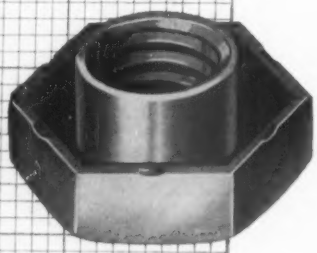

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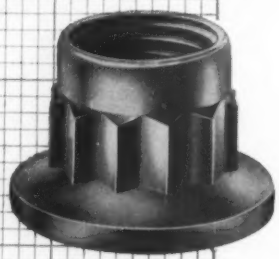

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